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INTRODUCTION OF CARMAN LECTURER[1]

By JOHN D. CAMP, M.D., President, Radiological Society of North America

THROUGHOUT the world it has become the custom of scientific bodies and institutions to honor the name of distinguished scientists by means of special lectures or lectureships. Three years ago the Radiological Society of North America inaugurated in honor of a great radiologist and a former president of this Society, the "Carman Lecture," which has become a significant feature of our annual meeting. This year the Radiological Society of North America has deferred its annual meeting in the interests of the Fifth International Congress of Radiology, and through the courtesy of the officers of this Congress we are privileged to bring to you as the official contribution of the Radiological Society of North America to the program of this meeting, the Fourth Annual "Carman Lecture."

The speaker who will address you needs little introduction to most of you, for his contributions to roentgenology, both as a scientist and teacher, are well known in this country and abroad. Last year marked the twenty-fifth year of his service as roentgenologist to the Massachusetts General Hospital in Boston. During this time his department has become an outstanding center for post-graduate radiologic training, and eighteen of his sixty official post-graduate students now hold professorships or teaching appointments in roentgenology in medical schools in this country and abroad. It may truly be said that he has reached the grandfather stage as a teacher, for many of his disciples have in turn passed on to a second generation the high ideals and principles of their former chief.

Many in this audience have pioneered in the science of radiology and have witnessed its growth to one of the leading recognized specialties of medicine. What the future holds in store for it is intimately linked with the education of those who are to follow us. How to best impart to them the knowledge and principles of this great specialty is a problem of serious moment to those who are responsible for the guidance of organized radiology. For this reason the lecture which is to follow is of great significance and it gives me great pleasure to introduce to you the Fourth Carman Lecturer, Dr. George Winslow Holmes, Clinical Professor of Radiology at Harvard Medical School, who will address you on the subject: "The Development of Post-graduate Teaching in Radiology."

[1] On the same evening, Dr. Camp, as representative of the Radiological Society of North America, presented the Gold Medal of the Society to Dr. Holmes, naming him as "one whose contributions to scientific radiology are of world-wide renown, one whose eminence in the field of education in radiology is unchallenged, and one who was a pioneer in the development of the tumor clinic as a scientific means for the study and treatment of cancer and neoplastic disease."

THE DEVELOPMENT OF POST-GRADUATE TEACHING IN RADIOLOGY

By GEORGE W. HOLMES, M.D., *Boston*
Clinical Professor of Roentgenology, Harvard Medical School, and Chief of the Roentgenological Service of the Massachusetts General Hospital

THE Carman Lecture was established by the Radiological Society of North America at its twentieth annual meeting in Memphis, Tenn., on Dec. 3, 1934, to do honor to the memory of a great radiologist. On an occasion such as this, when radiologists from various countries are gathered, it is fitting to review the life of the man in whose honor we are assembled.

Russell Daniel Carman was born at Iroquois, Ontario, Canada, on March 18, 1875. He came to the United States in boyhood and later became a citizen of this country. His early education was obtained at Minneapolis Academy, and the first two years of his medical training at the University of Minnesota. He then went to St. Louis, Mo., where he completed his course in medicine at the Marion-Sims College, receiving the degree of Doctor of Medicine in 1901. At the end of one year's post-graduate work at Johns Hopkins Medical School in Baltimore, he returned to St. Louis to practise medicine.

In 1902 radiology was in its infancy, and Carman became one of its early disciples. Recognized as a leader in his field, he was invited to the Chair of Professor of Roentgenology at the Medical School of St. Louis University, from which he resigned to take a similar position at Washington University. Jan. 1, 1913, upon the joint invitation of the Staff, he became head of the Section of Roentgenology at the Mayo Clinic, and retained this position until his death in 1926. Through his long association with this great institution he did much to place radiology as a specialty of medicine upon the firm foundation which it now occupies.

Carman will always be remembered for his contributions to the roentgenological diagnosis of diseases of the gastro-intestinal tract. The present high standard of diagnosis in this field is probably due more to his efforts than to those of any other one American. The magnitude of his work in gastro-intestinal diagnosis has somewhat obscured his contributions in other fields. Carman was not only a great diagnostician but a great teacher, and it is this phase of his work which should interest us particularly this evening. As a teacher he recognized two principles which seem to me to be of the greatest importance in the development of radiology. First, the careful selection of the individuals who are to enter this field of endeavor; and second, a planned, adequate, supervised course of instruction. That he was highly successful in his selection of candidates is amply shown by the men whom he left to succeed him. Among these are Dr. B. R. Kirklin, who is the present head of the Section of Roentgenology at the Mayo Clinic, and President of the American Roentgen Ray Society, and Dr. John D. Camp, whom you have honored with the Presidency of your Society. The real measure of a great teacher is found not in the number of students who pass through his clinic, but in the number, though they may be few, who become recognized leaders in the science which he represents. Judged by this standard Carman was eminently successful.

The establishment of the Mayo Foundation in 1916 gave Carman an opportunity to take part in the development of a three-year course of post-graduate instruction in the specialties. This plan has since been adopted, with some modifications, in many of the more important teaching institutions in this country. The development of post-graduate teaching in radiology, which is the subject of our discussion this evening, owes much to Russell Carman.

The training of men in the medical specialties is a subject of great interest to physicians and to teachers throughout America to-day. This interest has been

augmented by the establishment of examining boards in each of the various specialties and by an attempt on the part of organized medicine to raise the standards of teaching. Before attempting to outline a program of instruction in any special medical field, and particularly in radiology, it seems to me desirable to review briefly the methods of teaching used in the past through which our present leaders received their instruction. In addition we should determine, as far as possible, the number of radiologists necessary to carry on the work and should know in which institutions adequate training may be obtained. In other words, how have our leaders in the past been trained? How many roentgenologists are necessary? What are the present facilities for training them?

In the early days of medicine in this country, specialization was entirely a matter of individual growth. If a physician showed some aptitude for certain phases of medicine, or became particularly interested in some one disease, patients were referred to him by his colleagues, or came directly to him because of the feeling in his community that he was particularly fitted to treat such conditions. Gradually, a large proportion of his practice was taken up with certain groups of cases—those requiring a special technic in treatment or those suffering from a specific disease. In this way his knowledge of his subject became greater, and he was finally recognized as a specialist in that particular field. Some of these men supplemented their experience with special courses taken in the large hospitals of Europe. Later, as adequate teaching hospitals developed in this country, men with special aptitude in certain fields of medicine, or others who had acquired a considerable experience in some particular field, associated themselves with these hospitals and became teachers in the medical schools as well as specialists in practice.

As the hospital and medical school assumed greater importance in the field of medicine it became the custom for medical graduates to associate themselves with hospitals as interns before entering practice. Selected candidates from this group became assistants to their teachers and instructors, not only in hospital work but in private practice. By constant association with the master these students were prepared to continue as specialists in their chosen fields. This system, when operating at its best, was probably as nearly ideal as could be devised. The candidates were naturally very carefully selected after a long period of observation and were advanced only as they showed ability. They received not only instruction in the *science* of medicine but also in the *art* of medicine, as it is seen in private practice. It was the apprentice system carried to the highest degree of development.

Unfortunately, this plan did not produce the number of men necessary for the rapidly increasing demand for specialization, and the increasing growth of the population. Various short-cuts were attempted, the most pernicious of these being the short courses given to the general practitioner who wished to specialize in some field of medicine largely because specialization seemed to offer a more interesting and an easier way of earning a livelihood. These courses reached their highest development in the great teaching hospitals of Europe. As a result of this practice large numbers of inadequately trained men appeared in the various fields of specialized medicine.

Early in the twentieth century, in an attempt to give better service to the ward patients and to relieve, to some extent, the overworked visiting staff, hospitals began to establish residencies in medicine and surgery, and somewhat later in the medical and surgical specialties. These residents, selected from the interns, continued their work in the hospital for varying periods of time, usually a year or more, the hospital supplying board and room, and in some instances a small salary. The duties of the resident were similar to those of a junior member of the staff. This movement had a rapid growth and is now generally accepted in all teaching hospitals. The number of residents on each service has in-

creased and practically all specialties are now represented. The residency system has supplemented, and to some extent replaced, the apprentice or assistant system. Its advantages over the older method are: first, that it increases the number of men trained, and second, that the present-day resident receives a better training in the scientific aspects of medicine than did his predecessor, the assistant to the specialist in private practice. Its disadvantages are that the selection, while good, is not as personal as in the older system, and the student lacks training in the *art* of medicine, which can be obtained only in private practice.

In 1916, the Mayo Foundation established fellowships in medicine leading to a master's degree. This course of training included the residency, and, in addition, special training in the fundamental sciences with periodic examinations and the writing of a thesis. If the student's work was satisfactory, he was awarded a diploma. This idea, with various modifications, has been adopted in several of our larger universities. The principal objection to the plan is financial. At the Mayo Clinic the scholarships are adequately financed, but in some institutions only two years of the course, that part devoted to the residency, can be properly financed. Until a sufficient number of endowed fellowships are available the general adoption of this excellent plan is doubtful.

From this brief review it is obvious that the character of training received by physicians, holding themselves out to the public as specialists in the various fields of medicine has differed widely in methods and results. We have, first, the general practitioner, who on his own initiative decided to become a specialist and who has received inadequate training through short courses; second, the hospital resident who has had from one to two years of training in a hospital more or less equipped for such training, and lastly, the Fellow who has had three years of supervised work in an institution especially adapted for such training. As a result many poorly trained "specialists" have been produced. For some time there has been a concerted effort on the part of organized medicine, and of the general public, to establish standards to which any physician specializing in any branch of medicine should conform.

In some States plans were made to establish licensing boards for the examination of specialists similar to the State licensing boards in general medicine. It is the feeling of organized medicine that this is not the answer to the problem. It may well be the function of the State to determine whether or not a physician may safely practise the "healing art" within its borders, but it is not its function to determine whether or not he possesses the special qualifications required of a specialist. This function belongs in the hands of his fellow-physicians. To prevent the growth of this movement on the part of the State, and to establish standards to which all specialists should conform, examining boards in the various specialties were established. The personnel of these boards is selected from the national societies representing the specialty, and the board receives its authority through the Council on Medical Education and Hospitals of the American Medical Association. Uniform standards throughout the various special fields, including certain requirements as to previous training before a candidate is accepted for examination, have been adopted. A successful candidate is given a certificate stating that the Board recognizes him as a specialist in his chosen field The examination is not obligatory. A physician not holding a certificate is not prevented from practising in the specialties. He is not, however, listed as a specialist in the Directory of the American Medical Association, and his promotion in hospitals and universities is regulated to some extent. Furthermore, those candidates receiving certificates comprise a list from which physicians or patients seeking a specialist may choose.

The establishment of such examining boards has made it necessary to develop more uniform and definite methods of

training physicians in the various specialties. If these boards are to demand certain standards of training and education before an applicant may be accepted for examination, they must, in turn, supply the facilities by which candidates in sufficient numbers to meet the demand in the various cities and towns may receive such training.

The American Medical Association lists 1,522 physicians in the United States as specializing in radiology, and probably there are as many more unlisted. The American Board of Radiology has received applications from 1,139 physicians, and has issued certificates to 849 radiologists.[1] It is safe to assume that there are at least 3,000 physicians practising radiology in the United States at the present time. The life expectancy at the age of 30 years, when most candidates begin their work in a special field, is estimated at 35 years, which coincides with the usual retirement age of 65. This seems to place the maximum years of active practice in a specialty at between 30 and 35 years. The annual death rate of the adult population of the United States for all ages above 19 years is 15.7 per 1,000. To maintain the present number of physicians listed as practising radiology as a specialty it is, therefore, necessary to bring into the field annually at least 70 new men. If the number of men practising radiology is placed at 3,000, which is more probable, the number of men available each year should be doubled. This number would not take care of any increase in demand, nor of any vacancies created by men who for various reasons leave the specialty.

In the "Journal of the American Medical Association," Aug. 29, 1936, Vol. 107, there is a list of hospitals in the United States approved by the Council on Medical Education and Hospitals of the American Medical Association for residencies in the specialties. Fifty-three approved hospitals offer residencies in radiology. It is probable that this estimate is large rather than small. If we accept the statement that there are 53 hospitals in the United States offering satisfactory residencies in radiology, and assume that the course of training is at least two years, also that the average hospital can accommodate two residents, the possible number of new radiologists available annually would not be over 53. If the course of residency is raised to three years, as has been suggested, this number would be materially reduced.

From the figures just quoted it is obvious that the facilities for training radiologists are already inadequate, and that any raising of standards must, therefore, be accompanied by increased facilities for the training of candidates. Any plan which is adopted must utilize to the fullest the present teaching facilities as well as any new fields which may become available. Also, it should offer opportunity for additional training to the younger men already specializing in radiology, who are not able to meet the requirements of the examining boards. Since success in a specialty, particularly in radiology, is definitely dependent upon constant study and the acquiring of new knowledge, the plan should recognize this fact by offering "refresher courses" at the great medical centers for those specialists located in the smaller towns where advanced information is not easily available.

From this review of past and present methods of teaching in radiology, the problem can be visualized and certain recommendations as to future methods of teaching may be made. We should maintain at least three thousand properly trained specialists in radiology in the United States. Any smaller number will be insufficient to meet the public need, and as a result inadequately trained men will take this opportunity to establish themselves in the specialty. At least two types of men are necessary, each possibly requiring somewhat different training. First, there is that great group of roentgenologists who carry on the bulk of the routine work in our smaller hospitals and in private practice. Second, there are those men, leaders in our specialty, who are to do the

[1] June, 1937.

teaching and research work. The latter are usually located in the large teaching centers and their number is much smaller than that of the first group.

The demand for teaching, therefore, naturally divides itself into three groups: first, the so-called "refresher courses" for those men already in the field; second, opportunity for adequate training of the men who are to do the routine work of the specialty, and third, the development of such courses as will attract to this specialty some of the best minds among the younger generation in medicine, and will afford them ample opportunity to develop as teachers and investigators in their chosen field.

We should recognize in the consideration of our problem certain principles in teaching which have come down to us from the past. First, there is the didactic method of instruction—the direct transmission of knowledge from teacher to pupil. The pupil asks a question and the teacher answers it, either directly or by means of lectures. This is the method adopted to a large extent in our public schools and is most successful in the teaching of children. It is natural for children to ask questions and to expect a positive answer. This method has also been successfully used in the preparation of large numbers of men to meet certain definite requirements. The student is equipped with facts which allow him to accomplish a given task. He is not, however, prepared for the acquisition of knowledge on his own initiative, and if the didactic method is carried too far it may actually hinder his development.

The second method of teaching is by experimentation and discussion. This may well be called the "adult method." There is a time in the life of every boy when he ceases to be satisfied with having his questions answered by an instructor, when he prefers or insists upon finding out these things for himself. When this age is reached the didactic method of instruction is no longer helpful. If the student is to reach his highest development, he must be given an opportunity to investigate for himself under supervision. This age probably varies considerably with the individual, but it is safe to assume that between the ages of 25 and 30, when most men begin their studies in the specialties, they have passed the time when methods of instruction adapted to childhood teaching should be used, and are ready for one which puts them more or less on their own initiative. The method of choice should be one which teaches them to think correctly and to master each problem as it arises by individual study and experimentation.

Most thinking men agree that to build on the acquired knowledge of the past is better than to attempt revolution. Older methods should be improved, the good retained and the bad discarded; they should not be replaced by new, untried systems.

A proper course of instruction to meet our requirements should, I believe, be based upon the hospital residency rather than upon the so-called "post-graduate medical school." The candidate should be selected by the hospital for the position of resident before he is allowed to matriculate at the university. In no other way will the most important part of our program be carried out, namely, the selection of the candidate and the certainty that he will receive the required training in the clinical aspects of the specialty. Advanced training in the fundamental sciences, examinations, and the writing of a thesis leading to a degree may well be the function of the university, but these things are secondary to the careful selection of the candidates themselves and their training in the clinic.

The Executive Committee of the Massachusetts General Hospital appointed a sub-committee to arrange a program of instruction for residents in the specialties to meet the requirements of the examining boards. This committee met on Oct. 29, 1936, at which time the recommendations of the Advisory Board on Medical Specialties, as published by their secretary, were discussed. It was generally agreed that the various departments at this hospital should conform, as nearly as possible, with these recommendations. Each department head

was instructed to prepare a plan for his own particular department which, in his opinion, would be satisfactory to meet the requirements.

After reviewing the material submitted by the various heads of departments and discussing the problem with teachers in other universities, as well as at Harvard, it was agreed that a course of instruction for specialists to meet the requirements of the examining boards should be based on our present method of teaching, namely, the hospital residency, rather than the establishment of a school for post-graduate teaching, and the following program was suggested:

"The course for residents at this hospital should be for one or more years as at present. The appointment, to be made annually, should preferably consist of a junior and a senior year, to which should be added one year as graduate assistant, house officer, or research fellow. The appointment as graduate assistant should preferably come before the residency, that of research fellow should preferably come after the residency.

"The graduate assistant would live outside the hospital, receiving no compensation. During the year he should take the basic sciences prescribed, and to this should be added a certain amount of work in the department of the hospital to which he is assigned. It might also be arranged to accept men as residents who have had this course in another institution, or who had served one year as house officer in the same department. Men selected for graduate assistants would naturally be those who, after completing their general internship, had had some additional work either in private practice or in the specialty.

"The work of the resident would be practically the same as at present, with the possible addition of special courses to complete his work in the basic sciences.

"The work of the research fellow would be a continuation of the work as resident. A research fellow would live outside the hospital and receive a maintenance salary, preferably from an endowment fund especially for such scholars. It is also possible that he be given a teaching position in the medical school with a small salary or that he receive a small salary from the hospital. During this period of service he would act as assistant in the department to which he was assigned and carry on some form of investigative work. He should be given sufficient free time to take courses in the basic sciences necessary to complete his work. These fellows would naturally be selected from the residents, but could be transferred from other institutions. They should be urged to prepare a thesis and to appear before an examining board for a master's degree.

"A plan such as this has several advantages. First, it does not interfere, materially, with our present plan, which has been satisfactory in the past. Second, it is flexible. Third, it provides for the two classes of physicians who are likely to apply for such training; namely, the man who after completing his internship enters private practice, and later decides to take up a specialty, and the man who intends to enter a specialty from the start and who wants to prepare himself to become a leader in his field."

Columbia University has also established a program of graduate medical education from which I quote:

"Proper training for a specialty includes three major phases. The first is a sound basic medical education, including a hospital internship, which is now regarded as part of that preparation. The second is advanced training in those medical sciences which are concerned particularly with the limited field of the specialty. The third phase is a long active clinical experience as a resident in a hospital equipped and staffed to provide graded responsibilities under the supervision of experts in the field of medicine selected."

They further state that

"after full consideration of the great importance to the medical profession, the hospital, and the public, of establishing graduate medical education at a high university level, the trustees of the university have created a higher degree to identify the individuals who obtain that recognition. Only residents holding an appointment in one of the affiliated hospitals are eligible for registration for the degree. Such residents are appointed by the hospital on the nomination of its own staff, as in the past. Those with proper qualifications who wish to register for the degree and are on a service approved by the university for the purpose may do so on the recommendation of the executive office of the department concerned. Each candidate will be expected to spend a part of his residency, or a period preceding it, in the medical sciences; present a program of scientific studies; write an acceptable thesis; and present himself for an examination in the field of study elected."

This plan, as in the one I have just outlined, permits the hospital to select the

candidate and to supply him with clinical experience. The university supervises his instruction in the basic sciences and permits him to try for a master's degree if he so desires. If such a plan were generally adopted, our problem would be relatively simple. It would be necessary only to add to our present system of residents, a certain number of endowed university fellowships so that no man of ability would be unable to complete his training because of lack of funds.

It would not be necessary for the student to receive all of his clinical instruction at one hospital. There are many hospitals in this country where splendid training in certain branches of radiology may be obtained, but in which a complete course in the subject would not be available. This is particularly true of the highly specialized hospitals. A candidate while serving an internship in this type of hospital might accumulate credit in the basic sciences at an affiliated university. It is not necessary that clinical experience be obtained in hospitals only. Time spent as an assistant in private practice with some of our leading radiologists might well be of equal or greater value to similar time spent as a hospital resident. The examining boards in the specialties should not be too specific in stating the requirements for examination by the boards. More responsibility should be placed upon the student, and he should be allowed to acquire credit from all recognized sources. The procedure for the training of the candidate for specialization in radiology might well be as follows: after graduation from a "Class A" medical school he should have at least one year's internship in a recognized hospital. This should preferably include both medicine and surgery. He should then apply for a residency in radiology in a well equipped teaching hospital. If his personality and qualifications are of the best, he may hope to obtain a residency in an institution which offers a three-year course including a fellowship covering the basic sciences and leading to a university degree. If he is unable to obtain such an appointment, he may accept a residency in a hospital offering a two-year course as resident. This may be followed by a residency of a shorter period in another hospital, preferably one which offers special training in some branch of radiology, during which time he may take the basic science courses in an affiliated university; or, after completing a certain period as hospital resident, he may associate himself with a radiologist in private practice as an assistant, during which time he will receive additional clinical training and take courses in the basic sciences. In this way it would even be possible for him to accumulate a sufficient number of credits which, with the presentation of a thesis, would justify the awarding of a master's degree by a university. Whatever the plan adopted, the details should be worked out by the individual hospitals and universities. Broad principles only should be laid down by the examining board. It is of the greatest importance that the plan shall permit of the training of a sufficient number of men to meet the demands of the community; that it shall utilize to the greatest extent our present facilities for teaching, and that the selection of candidates shall be adequately supervised. Any plan which does not recognize these general principles will defeat itself. It is my firm belief that much of our present trouble is due to the presence in radiology of poorly selected, inadequately trained men.

When we, as radiologists, include in our ranks a fair percentage of the great leaders in medicine, we will have no further difficulty with hospital boards and the general medical profession. Radiologists have, in the past, contributed much to our general knowledge of the diagnosis and treatment of disease, but this progress has been made by a relatively small group, and many of the great advances in our specialty have been made by other than radiologists.

If we are to take our proper place among the leaders in the advancement of medical science, it is necessary to attract to our specialty some of the best minds in the

younger generation of physicians and to offer them opportunities for prolonged training and research under the most favorable conditions. We have an abundance of clinical material which is rapidly being organized for teaching. Our greatest need is endowed university fellowships to the end that our present residencies may be supplemented by courses in the basic sciences leading to a master's degree.

Much progress has already been made, and I am sure that a satisfactory program will soon be completed. The future of radiology was never more promising than at the present time.

COLLOIDAL THORIUM IN THE LOCALIZATION OF DISEASE[1]

FURTHER EXPERIMENTAL DATA IN BONE TRAUMA AND INFECTION

By RAPHAEL POMERANZ, M.D., *Newark, N. J.*

THE retention and localization of colloids injected into the blood stream are determined by factors similar to those which condition the localization of blood-borne diseases. These factors are, according to Burrows (1): (1) Abnormal permeability of the walls of the small blood vessels; (2) forces capable of transmitting the noxious agents through the endothelial cytoplasm, and (3) retention of noxious agents in the tissues under the influence of inflammation. An electro-negative foreign substance, whether in colloidal form or not, will be removed from the blood stream by the reticulo-endothelial system, and its cells in the liver, spleen, bone marrow, and other organs. This process of permeation—or "diapiresis" as Burrows (1) calls it—will be further modified by other conditions, such as inflammation, concentration of hydrogen ions in the blood or extravascular tissues, conductivity of cells, ischemia, congestion, general shock, or body antigen reaction.

The present discussion will be limited to the use of colloidal thorium as the agent capable of visualizing reticulo-endothelial tissues, and to the value of this process in the localization of some diseases, with special reference to trauma and inflammation of bone.

Aschoff (2) introduced the term "reticulo-endothelial system" to describe a group of cells of mesenchymal origin, characterized by two common properties—phagocytosis and vital staining. These cells line the blood and lymph sinuses and are found chiefly in the liver, spleen, bone marrow, and lymph nodes, and to a lesser extent in the adrenals, hypophysis, and lungs. The distribution of these special cells is wide in area and diversified in form. Spleen and liver contain the largest amount, followed, in order, by the bone marrow, lymph nodes, omentum, serous cavities, lungs, suprarenal capsules, and pituitary body. The principal functions of these cells are phagocytosis, storage, and formation of antibodies, and the destruction of blood cells. However, these tissues also play a rôle in the defense mechanism of the body by promoting the elimination of bacterial toxins, cell products, and other poisons introduced into the blood stream. The reaction of the reticulo-endothelial system to disease is manifold. In acute infection the response is temporary phagocytic hyperplasia or the formation of antibodies. In some chronic infections, it produces a new type of cell from the histiocytes, forming granulation tissue. This occurs in tuberculosis, Hodgkin's disease, and the granulomas. In other chronic diseases, it responds with abnormal hyperplasia and excessive storage capacity as, for example, in Niemann-Pick's disease, or in the Schüller-Christian syndrome.

The roentgen visualization of an organ by means of thorium depends on the number and behavior of its reticulo-endothelial cells. This visualization may be accomplished by two methods—saturation and selective infiltration. The saturation of an organ with thorium may be partial or complete. Spleen and liver, for example, containing large numbers of reticulo-endothelial cells, will retain the bulk of the injected thorium—the spleen, as a rule, holding relatively more than the liver. By visualization in this manner, we can define the size, shape, and position of the organ. Any pathologic change which will destroy or replace parts of the liver or spleen, and thus destroy or replace parts of the reticulo-endothelial cell system, will be seen as a translucency in the otherwise homogeneous

[1] Presented before the Fifth International Congress of Radiology in Chicago, Sept. 13–17, 1937.

shadow of the organ. We may, in this way, recognize abscesses, cysts, metastatic areas, and cirrhosis, by alterations from the normal appearance of the shadows. Observation on a patient who retains thorium for a long period shows, even in normal subjects, a granular appearance in the liver and spleen shadow due to absorption and re-absorption of the thorium. Its transmission to the regional hepatic and other intra-abdominal glands may be observed. This redistribution of the thorium suggests that its absorption is not a stable process.

Fig. 1.

Thorotrast (Heyden) is the commercial name for the colloidal thorium introduced as an opaque substance for the visualization of the reticulo-endothelial system. Its merits are so well known and so well established by recent experimental and clinical work, that any listing of its advantages now would be superfluous. Still unanswered, however, is the question of its potentialities as a hazard to the hematopoietic centers arising from late radio-activity, because of poor elimination of the thorium. We do know, however, that patients observed for a period of six years still showed no evidence of the regenerative type of pernicious anemia, nor any bone malignancy. This has been reported by Martland (3) in his study of luminous dial workers.

Dosages now employed in clinical work have been reduced to a minimum. For visualization of the liver and spleen, from 25 to 40 c.c. are used. We are, at present, chiefly concerned with the introduction of even smaller amounts of thorotrast for the localization of disease. For this purpose we are using from 2 to 15 c.c. The minimum dose (from 25 to 40 c.c.) needed for the visualization of the liver and spleen amounts to about 0.45 to 0.72 microgram of radio-active material, as computed by Taft (4). This should be used only in elderly patients, and then only when malignancy or other serious disease is present. Smaller doses of thorium (from 2 to 15 c.c.) may be used without hesitation in any case warranting its administration for diagnostic purposes, when other methods have failed. This dosage (from 2 to 15 c.c.) amounts to only 0.036 to 0.27 microgram of radio-active material. The peritoneum, pleura, nerves,

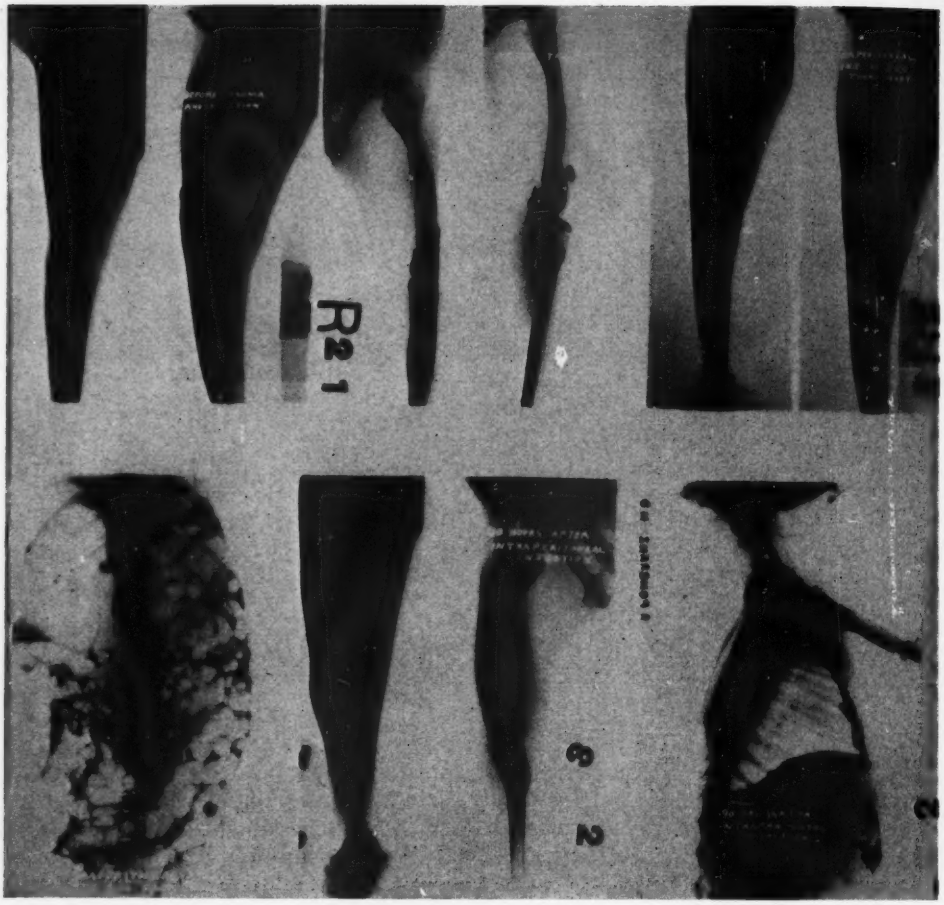


Fig. 2. Shows the serial radiographic follow-up of the traumatic lesions after intraperitoneal injection of 2 c.c. of thorotrast. (Also applies to Figure 3.)

meninges, lymph glands, and arteries of the brain or extremities can be visualized safely and clearly with these small amounts of thorium.

The visualization of bone marrow can be accomplished only by the saturation method, requiring larger doses of the medium; often, in fact, from three to six times as much thorium must be used in such cases as would be required for hepatolienography. Such large doses are usually prohibitive. After analyzing the work of other investigators based upon the inflammatory hyperplastic processes of the reticulo-endothelial cells (localized at the point of a bone infection), S. A. Sedgenidse and Solotuchin (5) performed a number of experiments on dogs. They injected two or three cubic centimeters of thorium intravenously into the femoral artery or vein, or into the carotid artery, following laceration of the femur. Radiographic examination made from 72 to 100 hours later disclosed a localized wave-like density over the point of trauma to the bone. Although these authors do not draw definite clinical conclusions, their work is of considerable theoretical significance.

We have studied this problem in a similar way, trying to visualize small focal le-

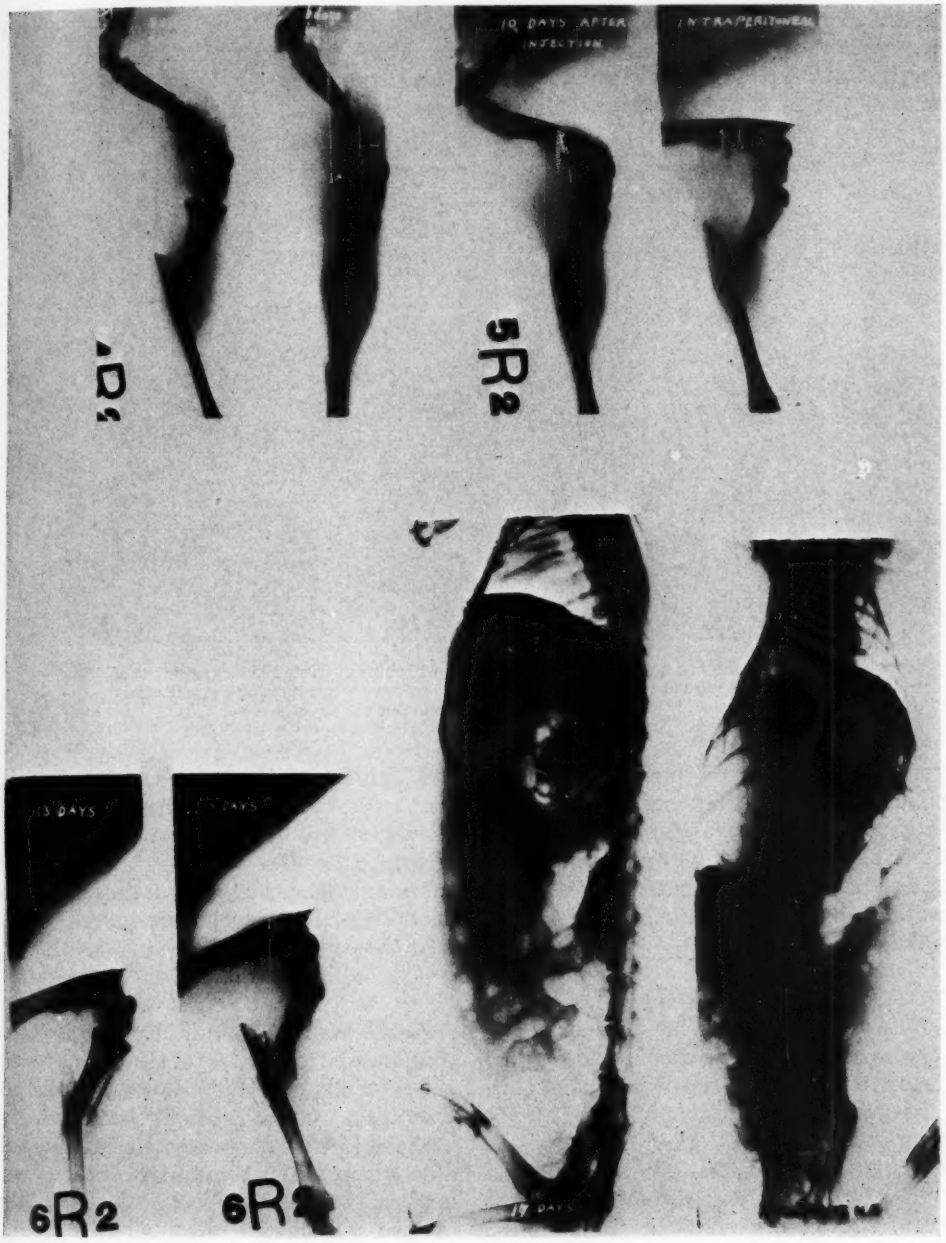


Fig. 3. See caption under Figure 2.

sions of bone by intravenous or intraperitoneal injections of small amounts of thorium. For this purpose, the following experiments were performed.

EXPERIMENTAL WORK

A number of rabbits of about the same age, each weighing between three and four pounds, were used. Having traumatized

the tibia or femur or both, we injected 2 c.c. of thorotrast, either intravenously or intraperitoneally, into each animal. In some of the rabbits, we subsequently introduced, locally or intravenously, 0.5 cubic centimeter of a 100 mi. suspension of *Staphylococcus aureus*. The trauma was either slight (consisting of pin-point penetration of the bone), or extensive; the latter took the form of comminuted fractures of the tibia or femur.

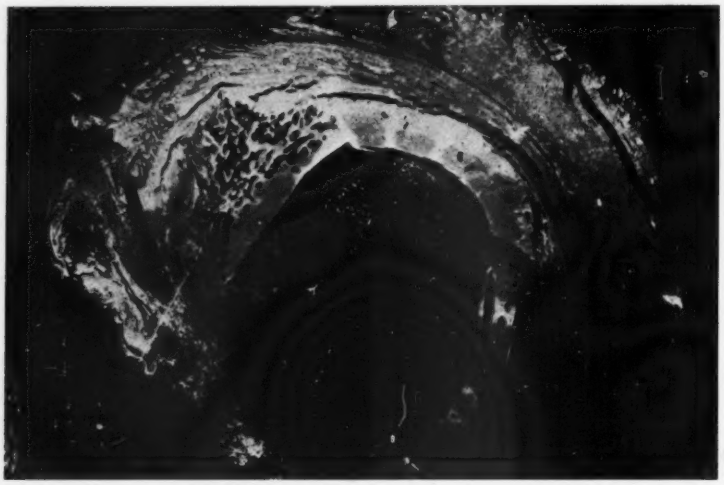


Fig. 4. Cross-section of tibia (magnification 15 times). Note the large amount of thorium granules in the active fibroblasts of connective tissue forming the soft callus, less in the osteoid tissue and bone marrow, and none in the solid bone.

EXPERIMENT NO. 1

Rabbits No. 1 and No. 5.—By means of a very fine needle, several pin-point punctures were made in the tibia and femur. Two days later, we injected 2 c.c. of thorotrast intravenously. Serial radiographic examinations were made covering the period between the day before the trauma and the autopsy, which was performed 150 hours after the injection of the thorium.

Roentgenographic Findings.—The small pin-point bone lesions showed progressively diminished clarity over the point of trauma. About 72 hours after the injection of thorium, a slight haze appeared over the point of the lesion. Rabbit No. 1 showed, in addition, a periosteal clouding which was noted 115 hours after the injection. At no time, however, could the cortical wave density described by Solotuchin (5) be found.

Microscopic Findings.—On the healthy side, the thorium granules were uniformly distributed within the reticuloendothelial cells. On the injured side, the thorium had accumulated in those reticuloendothelial cells which were found massed near the point of the trauma (Fig. 1).

EXPERIMENT NO. 2

Rabbit No. 2.—The injury consisted of comminuted fractures of the femur and tibia. Following this trauma, 2 c.c. of thorotrast were injected intraperitoneally. The extremities and chest were then serially x-rayed until autopsy, which was performed 17 days after the injection of the opaque medium.

Roentgenographic Findings (Figs. 2 and 3).—X-ray examination disclosed multiple fractures of the femur and tibia. In the course of the formation of callus, greater density developed at the point of fractures earlier than might have been expected. At this time, the soft tissues were of unusually

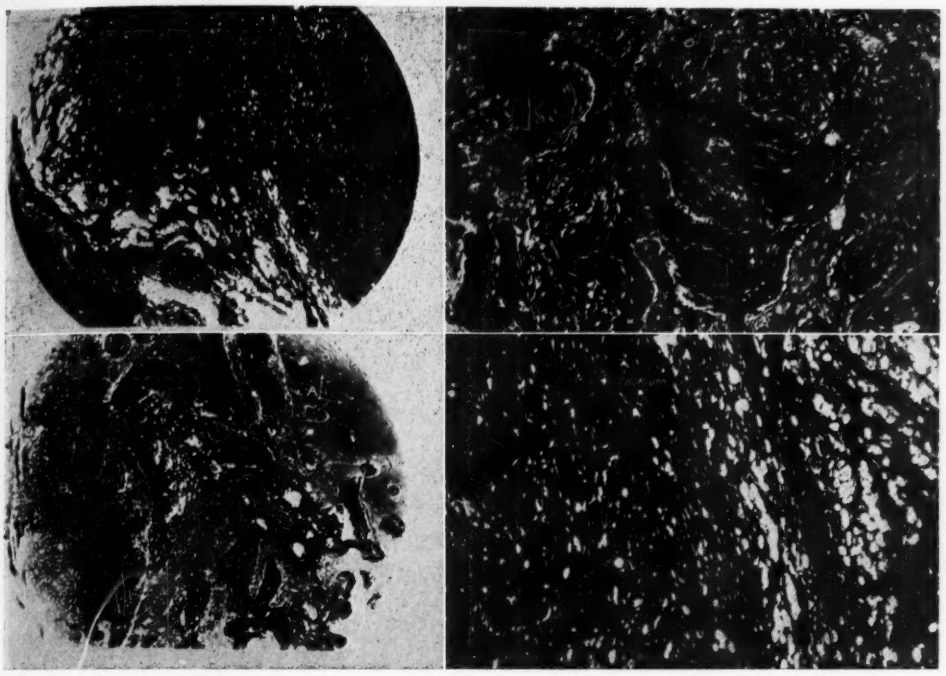


Fig. 5. Fig. 6.

Fig. 5 (*Upper*). Thorium in active fibroblasts. (*Lower*) (*A*) solid bone, (*B*) cartilage. Neither contains any thorium. Note some thorium granules in the osteoid tissue. (Magnification 150 times.)
Fig. 6. Shows the same distribution of thorium as Figure 5. (Magnification 350 times.)

granular consistency. This was due to the clumps of thorium found on histologic examination.

Microscopic Findings (Figs. 4, 5, and 6).—Solid bony callus firmly united most of the fragments of the femur. In the bone marrow, large clumps of thorium were distributed irregularly within the medullary cavity, chiefly near the fibrous parts of the new formed tissues. Wherever the new bone was firm, the amount of thorium was small.

EXPERIMENT NO. 3

Rabbit No. 3.—The trauma consisted of a pin-point lesion combined with a linear, cortical, longitudinal fracture at the lower third of the right tibia. Following this injury, 0.5 c.c. of 100 mi. suspension of *Staphylococcus aureus* was introduced locally. Twenty-four hours later, 2 c.c. of thorotrast was injected intravenously and, in addition, a gram of silica was injected intraperitoneally. Serial x-ray films were taken until the autopsy, on the ninth day after the trauma.

Radiographic Findings (Fig. 7).—The original pin-point lesion became hazy and was not sharply defined. Five days after the injection of thorium, a periosteal reaction was noted which persisted until the last examination, just prior to the autopsy.

Microscopic Findings.—About the pin-point lesion, the distribution of thorium in the bone marrow was analogous to that previously described. At the point of visualized periosteal reaction, a linear accumulation of thorium was seen. In this rabbit, a bronchopneumonic focal lesion developed in the lungs. Under high power, a number of very fine thorium granules were seen in the phagocytes (Fig. 8).

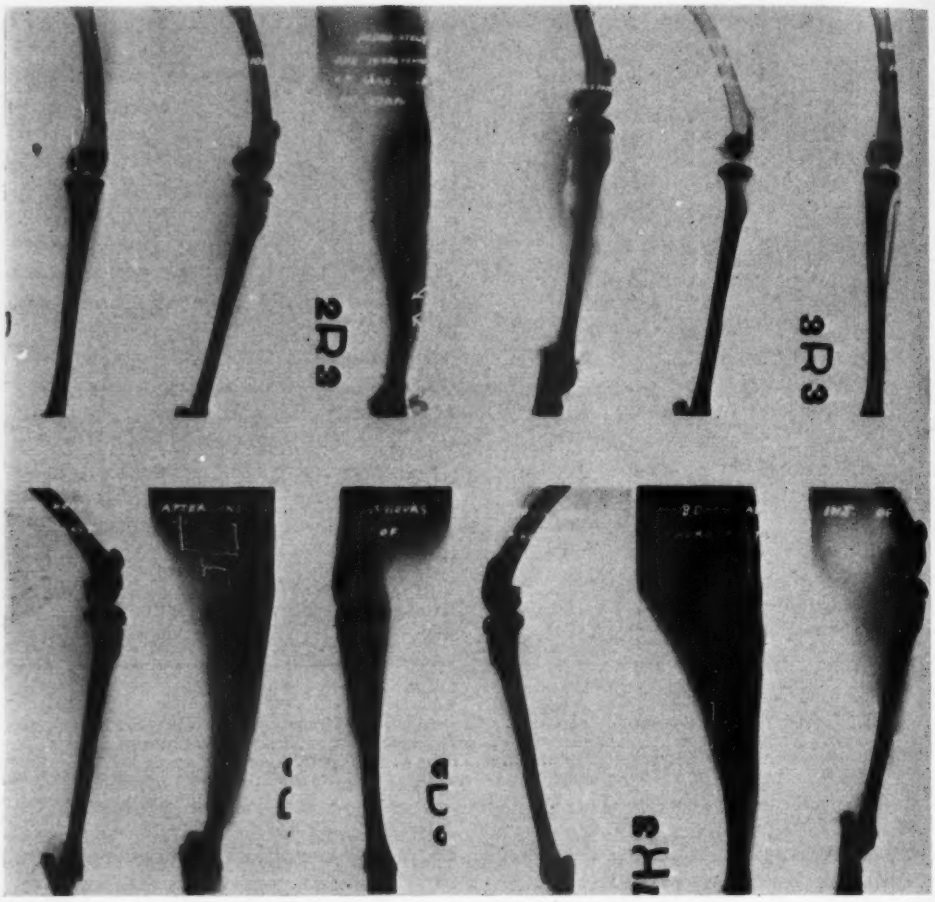


Fig. 7. Serial radiographic follow-up of Experiment No. 3.

EXPERIMENT NO. 4

Rabbit No. 4.—The trauma consisted of a pin-point lesion of the tibia. Two days later, 0.5 c.c. of 100 mi. suspension of bacteria was injected intravenously and 2 c.c. of thorotrast was administered intraperitoneally. Radiographic and microscopic findings were similar to those described in Experiment No. 1.

COMMENT

The microscopic findings in these experiments reveal that the thorium particles are evenly distributed in the uninjured extremity. On the other hand, the particles accumulated in large amount at the point of the lesion on the injured side. This was most clearly demonstrated in rabbit No. 2 (Experiment No. 2) in which the fractures were extensive. The distribution of thorium in the cells during the stage of callus formation is of particular interest. One can see a large number of thorium granules accumulated in an irregular manner in the active fibroblasts and histiocytes chiefly around the small capillaries and in the periosteum of the injured area. In cases in which the bone is intact, the periosteum shows practically no thorium. The corresponding area of bone marrow shows a rather uniform distribution of the thorium. On the site of the injury, the amount of thorium is almost three or four times as great. The newly formed cartilaginous

tissue shows practically no thorium. Whenever osteoid tissue is formed, thorium rapidly diminishes in amount. The osteoblasts show no evidence of thorium whatsoever. Occasionally some thorium granules in the newly formed bone can be seen. As a whole, however, most of the thorium has disappeared. It appears as if the bulk of the thorium has been taken up again by the new capillaries and carried away to other places.

It is obvious the smaller the lesion, the less the reaction, the fewer the accumulated reticulo-endothelial cells, and, therefore, the relatively less thorium. At no time was an effect on the general health of the rabbits observed. The bulk of the thorium was retained in the liver and spleen in each case. In rabbit No. 3, an infectious focus of infiltration was produced with the help of bacteria. In this instance many phagocytes were noted, but no significant amounts of thorium were associated with these cells. This may be explained by the following hypothesis: before the focus developed, all the thorium had already been absorbed by the reticulo-endothelial cells of the other organs, so that very little of it filtered through from the blood stream into the lung lesion. Further experimental study of inflammatory lung lesions is, therefore, needed and would be of great theoretical value.

Roentgenographic findings in all our experiments show lack of clearness and increased density of the injured area sooner than otherwise expected, usually 72 hours after the injection. Occasional periosteal clouding and even early periosteal apposition can be noted which apparently are due to local deposits of thorium. In our experiments we were unable to produce the wave-like density described by Solotuchin, which may be attributed to change in our technic; the site of the injection and the interval of the x-ray examination were different from his experiments.

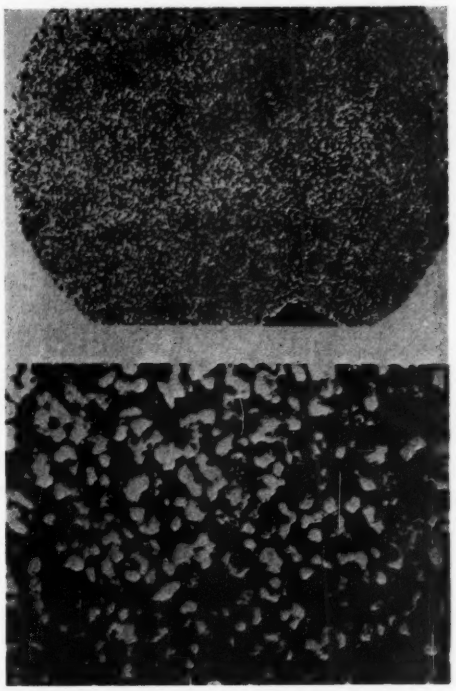


Fig. 8. Thorium granules in phagocytes of an artificially produced focal bronchopneumonic lesion. (*Upper* shows low power; *lower* shows high power magnification.)

SUMMARY AND CONCLUSIONS

1. Colloidal thorium is an excellent medium for the experimental visualization and study of the reticulo-endothelial system in health and disease.

2. Its clinical use in human adults should be restricted to those cases in which its lifelong retention is not hazardous, *e.g.*, in malignancies, leukemia, and similar conditions.

3. When used in this manner, it should be critically evaluated by the microscopic study of tissues obtained at autopsy in a large series of cases collected over a period of years.

4. Animal experimental work with small doses of thorium for the visualization of small infectious bone lesions is valuable for the study of reticulo-endothelial cells under the influence of inflammation.

5. Judgment as to the clinical use of such doses in human beings must be withheld until more extensive experimental data are secured. In the intravenous use of thorium, one should heed the warning of

Martland (3) and other investigators, not to increase the radio-activity of the human body because of the danger of late induction of bone malignancies. The elapsed time of seven years is insufficient as a criterion of its safety.

In conclusion, I wish to thank Dr. H. S. Martland for his kind help in preparation of the photomicrographs. I also wish to express my appreciation to I. R. Asen, chemist, and his co-worker, for their able assistance, as well as to the Heyden Chemical Co. for the supply of thorotrast used in these experiments.

REFERENCES

(1) BURROWS, H.: Some Factors in the Localization of Disease in the Body, Wood, 1932.

(2) ASCHOFF, L.: Lectures on Pathology, 1924.

(3) MARTLAND, H. S.: Occupational Poisoning in Manufacture of Luminous Watch Dials. Jour. Am. Med. Assn., Feb. 9, 1929, **92,** 466; Feb. 16, 1929, **92,** 552.

Idem: The Occurrence of Malignancy in Radio-active Persons. Am. Jour. Cancer, October, 1931, **15,** 2435–2516.

Idem: The Danger of Increasing the Normal Radio-activity of the Human Body. E. Libman Anniv. Vols., October, 1932, **2,** 781–791.

(4) TAFT, R. B.: Determination of the Gamma-ray Activity of Thorotrast in Living Patients. Prelim. Report. American Roentgen Ray Society meeting, September, 1936, Cleveland, Ohio.

(5) SEDGENIDSE, G. A., and SOLOTUCHIN, A. S.: Über Röntgendiagnostik entzündlicher Herde im Knochengewebe mittels geringer "Thorotrast"—Dosen. Fortschr. a. d. Geb. d. Röntgenstrahlen, December, 1934, **50,** 556–562.

MEASUREMENT OF ROENTGEN-RAY DOSAGE BY DETERMINING THE EFFECT OF RADIATION ON CHROMOSOMES

By ALFRED MARSHAK, PH.D., Laboratory of Pathology, N. E. Deaconess Hospital, *and* J. CRAMER HUDSON, PH.D., Collis P. Huntington Memorial Hospital, *Boston*

WHILE the generally accepted method of measuring roentgen-ray dosage is by means of ionization chambers, the use of biological test objects also is of considerable importance since the radiologist is primarily interested in the biological effects of radiation. However, if the desired relationship between the biological unit of effect and the roentgen is to be known, it is necessary that the biological response used be independent of wave length within the range of wave lengths used or that the function relating response and wave length be known for every dose. Obviously for radiation generated at voltages in the neighborhood of 1,000 kv. the necessary conditions cannot be fulfilled at present, since there is no accepted method of measuring dosage in roentgens at these high voltages. Consequently it is desirable that the biological response studied be one which is fundamental to all organisms, since only under such circumstances can experimental results obtained with one organism be used as a basis of prediction of effects in others. It is particularly significant if the response can be related to one type of reaction which is desired in the treatment of neoplastic disease. Chromosome division is a process which has been shown to have quantitatively similar characteristics in all the different plant meristematic tissues and mammalian tumors studied thus far (28). Therefore the production of chromosome abnormalities should serve as a suitable means of quantitative dosage measurement. Several other biological objects and processes have been studied by various investigators and some of these will be mentioned briefly after the presentation of the data.

PROCEDURE

Three different qualities of radiation were used in the present experimental work, the first generated at 120 kv., the second at 180 kv., and the third at 400 kv. The first two were generated by a Westinghouse quadrocondex machine, using a tungsten tube with a large thin target. The third type of radiation was generated by a General Electric 400 kv. machine, using an oil-cooled roentgen-ray tube. Both these machines are installed in the Palmer Memorial Hospital, Boston.

The conditions of operation of the machines are shown in the accompanying Table I.

All voltages are measured by means of a spark gap. The filter in the case of the 400 kv. machine includes the estimated equivalent copper filter in the tube itself. The intensity in roentgens per minute was measured by means of a Victoreen condenser type r-meter. This meter has been calibrated several times against a standard parallel plate air chamber set up permanently for calibration purposes in the Collis

TABLE I

Kilovolts	Current	Filter	Treatment Distance	Intensity, r/min.	Half Value Layer
120	8 ma.	5 mm. celluloid	54 cm.	18.8	4.9 mm. Al
180	8 ma.	0.5 mm. Cu, 5 mm. celluloid	50 cm.	18.1	1.0 mm. Cu
400	5 ma.	5 mm. Cu, 0.9 mm. Sn, 1 mm. Al	50 cm.	21.5	5.9 mm. Cu

P. Huntington Memorial Hospital, Boston. At no time did the r-meter show departures from the standard chamber readings of as much as 1 per cent.

In order to have comparable treatment times the intensity of the 400 kv. radiation was measured and the conditions for the two other qualities of radiation arranged to give about the same intensity as that from the 400 kv. machine. This was in the neighborhood of 20 r per minute. All intensity measurements were taken in air without back-scatter and since the biological material is relatively small and placed on very thin filter paper and cellophane, the irradiation is carried out essentially in air without back-scatter.

The quality of the radiation in each case is determined by measuring the half value layer either in aluminum or copper. In these experiments various sheets of aluminum or copper are added and the intensity of radiation determined after the addition of each sheet. By plotting intensity against thickness of added filter the half value layer may be easily determined.

Commercial onion seeds of the variety known as Ohio Yellow Globe, obtained from the Ferry Seed Company, were used throughout this experiment. The seeds were treated with the filtrate from a suspension of bleaching powder, $Ca(ClO_2)_2$, for from one to two hours, rinsed several times in sterile distilled water and then allowed to soak for five or six hours in sterile distilled water in a Petri dish. The seeds were then transferred to Petri dishes containing filter papers moistened with sterile distilled water and incubated at 23° C. for six days. Seedlings with radicles 1.0 cm. or more in length were removed for use in the experiment, the rest returned to the incubator and seedlings again selected on the following day until the supply was exhausted or became infected. Since a single large Petri dish will hold several hundred seeds, a practically continuous supply of seedlings was maintained in this manner with a small expenditure of labor. This was very convenient since the roentgen machines were available only when not in use for therapeutic purposes.

It is unnecessary for the purposes of this experiment to have the seedlings in any exact stage of development, but it is desirable to have them in a condition which approaches a maximum rate of mitosis in the root tip. Seedlings with roots about one centimeter long or longer may be used up to the stage at which lateral roots appear.

For exposure to the roentgen rays, seedlings were placed between two Whatman No. 1 filter papers of 9 cm. diameter held between two sheets of cellophane supported by an ordinary wooden embroidery hoop with a 17 cm. inside diameter. The hoop was placed directly on the celluloid filter of the portal in exposures at 180 kv., while at the other two voltages the hoop was held by a ring stand at the required distance from the target of the tube.

After irradiation the seedlings were returned to Petri dishes and incubated for three hours at 23° C. They were then placed in a fixing fluid and a few hours later slides were prepared by a smear technic. If it is more convenient, the material may be left in the fixative for several days. A detailed account of the method of preparation of the slides will be presented elsewhere. It is of interest here to note the fact that it takes little more time to prepare such slides than it does to make blood smears.

The seedlings were exposed to a series of different doses of roentgen rays, and the number of normal and abnormal anaphases in the root tips at three hours after irradiation was determined by microscopic examination using a 10 × ocular and a 20 × objective. Doubtful cells were examined with this ocular and either a 45 × objective or a 90 × oil-immersion objective. An abnormal anaphase is defined as one showing one or more attached or fragmented chromosomes. In order to obtain consistent and reproducible results it is necessary to use only the late anaphases in which the distal ends of the chromosomes have become well separated. (Care must be

taken to exclude telophases which can be distinguished by the appearance of the nuclear membrane and of the nuclear lymph and nucleolus.) In such late anaphases attached chromosomes can readily be distinguished from those separating normally, while fragments will usually be found lying between the two groups of separating chromosomes in the region of the "metaphase plate." The accompanying photograph (Fig. 1), illustrates an attachment and a fragment.

In order to determine whether or not there is any significant subjective element entering into the determination of the percentage of unaffected cells, groups of seedlings were irradiated by one of us (J. C. H.), the dose being unknown to the other (A. M.). The latter then determined the dose from the survival curve (Fig. 3). These values were then compared with the dose as measured directly. For 120 kv. radiation the dose from the curve was 198 r compared with 200 r as measured by the dosimeter, and for 400 kv. the values were 203 r and 200 r, respectively. This close agreement indicates freedom of the technic from any appreciable subjective error.

The results of a number of counts are given in Table II. From the data it is evident that there is no significant difference in the percentage of cells which remain normal after treatment with equal roentgen doses at the three qualities of radiation. There is an apparent exception in experiment 141, for 400 kv. radiation, in which the percentage of normal cells is low. In this case, however, a fungus-infected culture was used and in order to have sufficient healthy material, the whole mass of seedlings was placed in the roentgen-ray field and the healthy ones selected after exposure and fixation. Since such a procedure introduces an obvious error due to scattering, the experiment was repeated using uninfected seedlings which were spread flat upon the filter paper in the usual manner and not massed. The values obtained from this lot, Experiment 142, agreed well with those obtained previously at 120 kv. and 180 kv.

There is another apparent discrepancy between the values of 40 r at 180 kv. which gives 88 per cent normal, and the values at 120 kv. and 400 kv. which give 77 per cent and 82 per cent, respectively. Such a difference of about 10 per cent might be significant. However, the values for 40 r at 180 kv. were obtained early in the course of these experiments when the roentgen-ray machine was operated only ten or fifteen minutes before the exposure was made. Dosimeter measurements made afterward showed that it required half an hour of operation to bring the machine to its maximum steady output. The dose as calculated by time of exposure is, therefore, undoubtedly higher than the actual number of roentgens received, and the percentage of unaltered cells is consequently higher than is to be expected from the apparent dose. For this reason the difference observed here is not taken to indicate a difference in efficiency of different wave lengths, but to indicate an error in technic.

The data may be presented graphically by plotting the percentage of normal cells

Fig. 1. Anaphase in *Allium cepa* three hours after receiving fifty roentgens. There are a pair of attached chromosomes in the center, while at the left a pair are breaking (by attenuation of a portion of the chromosome) to leave behind a pair of fragments. Magnification 1,690 times.

TABLE II

Dose in Roentgens	Voltage kv.	Experiment No.	Slide No.	Normal	Abnormal	Total No.	Percentage Normal
40	180	69	558	269	29	298	90.3
		71	562	40	6	46	87.1
		103	736	105	15	120	87.5
			737	272	46	318	85.5
			Totals	686	96	782	87.8
86	180	64	528	148	81	229	64.5
		96	679	135	128	263	51.4
			680	150	156	306	49.1
			Totals	433	365	798	54.4
173	180	68	552	27	111	138	19.6
		99	722	77	221	298	25.8
			723	39	122	161	24.2
			Totals	143	454	597	23.9
259	180	67	551	6	67	73	8.2
		58	511	4	53	57	7.0
		95	676	19	187	206	9.2
			677	10	151	161	6.2
			678	11	110	121	9.1
			Totals	50	568	618	8.8
346	180	94	674	6	89	95	6.3
			675	5	87	92	5.4
		100	724	4	127	131	3.1
			725	9	239	248	3.6
			726	6	181	187	3.2
			Totals	30	723	753	4.0
40	120	140	1–261	413	119	532	77.6
			1–262	325	107	432	75.2
			Totals	738	226	964	76.6
40	400	140	1–264	432	85	517	83.5
			1–265	256	71	327	78.3
			Totals	688	156	844	81.5
86	120	128	1–68	109	104	213	51.2
			1–70	215	198	413	52.1
			Totals	324	302	626	51.7
86	400	128	1–66	192	179	371	51.8
			1–67	131	111	242	54.1
			Totals	323	290	613	52.7
120	120	140	1–257	50	69	119	42.0
			1–258	125	146	271	46.1
			1–259	192	243	435	44.1
			Totals	367	458	825	44.5
120	400	140	1–266	190	171	361	52.6
			1–267	179	218	397	45.0
		141	1–274	55	128	183	30.0
			1–275	125	171	296	42.3
			1–276	36	43	79	45.5
			Totals	585	731	1316	44.4
200	120	141	1–272	27	120	147	18.4
			1–273	10	57	67	14.9
			Totals	37	177	214	17.3
	400	141	1–269	31	226	257	12.1
			1–270	30	184	214	14.0
			Totals	61	410	471	12.9
	400	142	1–277	68	358	426	16.0
			1–278	65	327	392	16.6
			1–279	51	306	357	14.3
			1–280	77	361	438	19.3
			Totals	261	1352	1613	16.2
		Controls					
		103	738	293	3	296	99.0
		58	495	314	12	326	96.4
			496	490	12	502	97.6
			497	414	4	418	99.0
		94	720	1061	16	1077	99.0
			721	556	8	564	98.8
			Totals	3128	55	3183	98.2

as a function of dose in roentgens for each voltage used. When this is done it is evident that the points for the three voltages

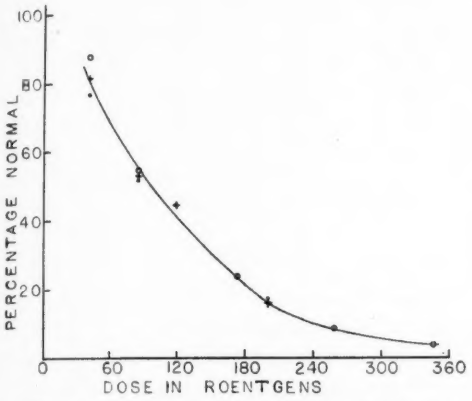


Fig. 2. The percentage normal anaphases as a function of dose in roentgens. Open circles denote points obtained with radiation at 180 kv., closed circles 120 kv., and crosses 400 kv.

used all fall on the same curve (Fig. 2). If the points be plotted on a semi-logarithmic grid a straight line results (Fig. 3), and since the slope of this line is readily determined it is useful in comparing the response of chromosomes to different qualities of radiation or of chromosomes of different organisms or tissues.

DISCUSSION

The data presented show that the material studied is markedly sensitive to radiation, 40 roentgens being sufficient to produce about 20 per cent effect. This is a considerably higher sensitivity than many of the materials used to measure biological response *e.g.*, *Drosophila* eggs (14, 15, 29); *Ascaris* eggs (3, 18, 41); wheat, lettuce, and lentil seedlings (15, 37); yeast (11, 20); bacteria (19, 21, 24, 39); fungi (36); protozoa (4, 35); gene mutation (12, 13, 30); tissue cultures (23, 32, 33, 34); fern spores (40), and others. Comparable sensitivities have been reported for *Axolotl* eggs (26) and for root elongation in *Vicia faba* (9, 10, 25). Results of these experiments indicate a very low biological variability as compared to the other processes and organisms and because of this low variability and marked sensitivity, the production of chromosome abnormalities in such material as

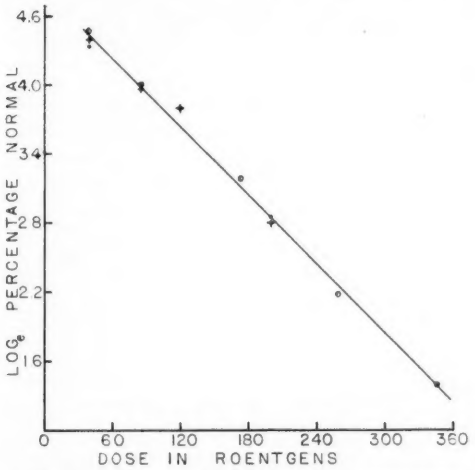


Fig. 3. The natural logarithms of the percentage normal cells as a function of dose in roentgens. Closed and open circles and crosses have the same significance as in Figure 2.

the root of the onion seedling makes a very satisfactory biological indicator of roentgen-ray dose.

There are other important advantages also. The seed is cheap and readily obtained, is easily germinated, and the response to radiation remains constant throughout the year. The response measured is not subject to diurnal variations such as have been demonstrated for the frequency of mitoses and root elongation (9, 37). The response can be determined in the relatively short period of a day or two.

Since the curves of the percentage of normal anaphases as a function of dose appear to be identical for the three voltages used there is apparently no wave length dependence within that range. It would seem, therefore, that this would make quite desirable material for the study of depth doses in a phantom. Before making such a study, however, it would be necessary to extend the study of wave length dependence much further into the soft roentgen-ray region, which may quite readily

be done. Furthermore, as demonstrated in a previous publication (28), it is possible by using different types of roots to cover a very wide dosage range. The range from 40 r to 1,000 r has been covered, but might easily be extended on either side.

Of biological phenomena studied by others, some, such as the effect on eggs of *Drosophila* (14, 15, 27) and on eggs of *Axolotl* (26), have been shown to be independent of wave length. The work of Holweck and Lacassagne (19, 20, 21, 24) and of Wyckoff (39) and Glocker (8, 11) has shown that bacteria and yeast are more readily killed by soft than by hard roentgen rays of comparable doses. On the other hand, different experimenters studying apparently the same phenomenon in similar organisms have reported conflicting results with regard to wave length dependence. Skin erythema has been considered independent of wave length by Hess, Holthusen, Determann, Jacobi and Holthusen, Glocker, Hayer and Jüngling, and dependent by Glasser and Meyer, Wintz and Rump, Reisner and Neeff, and Hudson. Root elongation of *Vicia faba* has been reported as independent of wave length (Glocker, Hayer and Jüngling) and dependent (Bolaffio, Björling, Lachmann and Stubbe, Glocker and Reuss). Abnormalities in *Ascaris* eggs were considered independent of wave length by Liechti and Holthusen and Zweifel and dependent though in different manners by Zuppinger and Dognon.

The presence or absence of any wave length dependence has interesting biological implications. If the production of chromosome abnormalities per roentgen is taken to be independent of wave length, it follows that changes in the size, *i.e.*, the amount of energy per quantum, do not produce any qualitative or quantitative alterations in the response of the radiosensitive material of the chromosome to the radiation. Glocker (8) has suggested that a biological response which is dependent on wave length might be so obscured by reactions secondary to the photo chemical action or by biological variability as to appear independent. In the case of chromosomes, however, the variability is quite low and since the response is a simple exponential function, *i.e.*, a first order reaction, it seems very unlikely that secondary reactions play any significant rôle in determining the independence observed. It would appear then that the ion pair and not the quantum is the agent effective in producing the chromosome abnormalities observed (28).

SUMMARY

The production of chromosome abnormalities in the cells of the root tips of onion seedlings has been studied as a biological method of measuring roentgen-ray dosage.

The ease of manipulation, low biological variability, and consistency of response make the method a very satisfactory one.

The biological response per roentgen is independent of wave length over the region studied. This is taken to indicate that the ion pair and not the quantum is the agent producing the effects observed.

REFERENCES

(1) Björling, E.: Eine Biologische Einheit bei Dosierung der Röntgenstrahlen. Strahlentherapie, 1930, **36,** 751–777.

(2) Bolaffio, M.: Versuche zur Luftelektrischen und Biologischen Wirkung von Strahlen Verschiedener Wellenlänge. Strahlentherapie, 1925, **20,** 673.

(3) Braun, R., and Holthusen, H.: Einfluss der Quantengrösse auf die Biologische Wirkung Verschiedener Röntgenstrahlenqualitäten. Strahlentherapie, 1929, **34,** 707.

(4) Crowther, J. A.: The Action of X-rays on *Colpidium colpoda*. Proc. Roy. Soc., B 100, 1926, page 390.

(5) Determann, A., Jacobi, H., and Holthusen, H.: Die Erythemwirkung Verschiedener Strahlenqualitäten auf Grund von Messungen in Röntgeneinheiten mit dem Küstnerschen Eichstandgerät. Strahlentherapie, 1927, **26,** 472.

(6) Dognon, A.: La Mesure et l'Action Biologique des Rayons X de Différentes Longeurs d'Onde. Jour. de Radiol. et d'Électrol., 1926, **10,** 145, 210.

(7) Glasser, O., and Meyer, W. H.: Erythemdosen in Röntgeneinheiten. Strahlentherapie, 1926, **23,** 361.

(8) Glocker, R.: Quantenphysik der Biologischen Röntgenstrahlungwirkung. Ztschr. f. Physik., 1932, **77,** 653.

(9) Glocker, R., Hayer, E., and Jüngling, O.: Über die Biologische Wirkung Verschiedener Röntgenstrahlenqualitäten bei Dosierung in R-Einheiten. Strahlentherapie, 1929, **32,** 1–38.

(10) GLOCKER, R., and REUSS, A.: Über die Wirkung von Röntgenstrahlen verschiedener Wellenlänge auf biologische Objekte, I. Strahlentherapie, 1933, **46,** 137–160.

(11) GLOCKER, R., LANGENDORFF, H., and REUSS, A.: Über die Wirkung von Röntgenstrahlen verschiedener Wellenlänge auf biologische Objekte, III. Strahlentherapie, 1933, **46,** 517–528.

(12) GOWEN, J. W., and GAY, E. H.: Gene Number, Kind and Size in *Drosophila*. Genetics, 1933, **18,** 1.

(13) HASKINS, C. P., and ENZMANN, E. V.: Note of a New and Apparently Useful Biological Indicator of X-ray Dosage. RADIOLOGY, February, 1937, **28,** 189–195.

(14) HENSHAW, P. S., and HENSHAW, C. T.: Changes in Susceptibility of *Drosophila* Eggs to X-rays. I.—A Correlation of Changes in Radiosensitivity with Stage in Development. RADIOLOGY, September, 1933, **21,** 239–251.

(15a) HENSHAW, P. S., and FRANCIS, D. S.: The Biological Measurement of Depth Dosage with 165 Kilovolts and 650 Kilovolts Roentgen Rays. Am. Jour. Roentgenol. and Rad. Ther., December, 1935, **34,** 789–797.

(15b) Idem.: A Consideration of the Biological Factors Influencing the Radiosensitivity of Cells. Jour. Cell. and Comp. Physiol., Dec. 20, 1935, 173–195.

(15c) Idem: The Biological Measurement of Gamma Rays in "Equivalent Roentgens." RADIOLOGY, November, 1936, **27,** 569–583.

(15d) Idem: The Influence of Wave Length on Depth Dose as Measured by Physical and Biological Means. RADIOLOGY, November, 1936, **27,** 293–300.

(16) HESS, P.: Die Härteabhängigkeit der R-Dosen in Vergleich zu Äquivalenten Erythemen Aller Gebrauchlichen Strahlenqualitäten. Strahlentherapie, 1927, **27,** 146.

(17) HOLTHUSEN, H.: Der Grundvorgang der Biologischen Strahlenwirkung. Strahlentherapie, 1927, **25,** 157.

(18) HOLTHUSEN, H., and ZWEIFEL, C.: Einfluss der Quantengrösse auf die biologische Wirkung verschiedener Strahlenqualitäten II. Das Schädigungsbild von Ascaris Megalocephala in Abhängigkeit von der Strahlenqualität. Strahlentherapie, 1932, **43,** 249–272.

(19) HOLWECK, F.: Production de Rayons X Monochromatique de Grande Longeur d'Onde. Action Quantique sur les Microbes. Compt. Rend. Acad. de Sci., Jan. 7, 1929, **188,** 197–199.

(20) Idem: Étude Énergétique de l'Action Biologique de Diverses Radiation. Compt. Rend. Acad. de Sci., 1930, **190,** 527.

(21) HOLWECK, F., and LACASSAGNE, A.: Étude de la Radiosensibilité du Bacillus prodigiosus aux Rayons X. Compt. Rend. Soc. de Biol., April 26 1929, **100,** 1101–1103.

(22) HUDSON, J. C., The Dependence of X-ray Erythema on Wave Length. RADIOLOGY, July, 1937, **29,** 95–98.

(23) KING, J. T., and STENSTROM, W.: Effect of Spaced Radiations on Lymphoid Cells in Tissue Culture. Proc. Soc. Exp. Biol. and Med., 1937, **36,** 597.

(24) LACASSAGNE, A.: Action des Rayons X de Grande Longeur d'Onde sur les Microbes. Établissement de Statistiques Précises de la Mortalité des Bactéries Irradiées. Compt. Rend. Acad. de sci., Jan. 7, 1929, **188,** 200–202.

(25) LACHMANN, E., and STUBBE, H.: Über die Biologische Wirkung der Grenzstrahlen, Verglichen mit Harten Röntgenstrahlen. Strahlentherapie, 1932, **43,** 489–516.

(26) LANGENDORFF, H., LANGENDORFF, M., and REUSS, A.: Über die Wirkung von Röntgenstrahlen Verschiedener Wellenlänge auf Biologische Objekte II. Strahlentherapie, 1933, **46,** 289.

(27) LIECHTI, A.: Über den Zeitfaktor der Biologischen Strahlenwirkung. Strahlentherapie, 1929, **33,** 1–54.

(28) MARSHAK, A.: The Effect of X-rays on Chromosomes in Mitosis. Proc. Nat. Acad. Sci., 1937, **23,** 362.

(29a) PACKARD, C.: The Quantitative Biological Effects of X-rays of Different Wave Lengths. Jour. Cancer Research, 1927, **11,** 1.

(29b) Idem: The Relation of Wave Length to the Death Rate of *Drosophila* Eggs. Jour. Cancer Research, March, 1929, **13,** 87–96.

(29c) Idem: Nomogram for Calculating X-ray Dosage. Jour. Cancer Research, October, 1930, **14,** 502–508.

(29d) Idem: The Biological Effectiveness of High-voltage and Low-voltage X-rays. Am. Jour. Cancer, November, 1932, **16,** 1257–1274.

(30) PICKHAN, A.: Vergleich der Mutationsauslösenden Wirkung von Röntgen- und Radiumstrahlen bei *Drosophila melanogaster*. Strahlentherapie, 1935, **52,** 369–388.

(31) REISNER, A., and NEEFF, T. C.: Hauttoleranzdosis und Strahlenqualität. Strahlentherapie, 1929, **34,** 313–339.

(32) SPEAR, F. G.: The Effect of Spaced Radiation on Tissue Cultures *in vitro*. Proc. Roy. Soc., B110, London, March, 1932, 224–234.

(33) STRANGEWAYS, T. S. P., and OAKLEY, H. E. H.: The Immediate Changes in Tissue Cells after Exposure to Soft X-rays while Growing *in vitro*. Proc. Roy. Soc., B95, 1923, page 375.

(34) STRANGEWAYS, T. S. P., and HOPWOOD, F. W.: The Effects of X-rays upon Mitotic Cell Division in Tissue Cultures *in vitro*. Proc. Roy. Soc., B100, 1926, page 283.

(35) TAYLOR, C. V., THOMAS, J. O., and BROWN, M. G.: Studies on Protozoa IV. Lethal Effects of the X-radiation of a Sterile Culture Medium for *Colpidium campylum*. Physiol. Zool., 1933, **6,** 467.

(36) UBER, F. M., and GODDARD, D. R.: Influence of Death Criteria on the X-ray Survival Curves of the Fungus *Neurospora*. Jour. Gen. Physiol., 1933–34, **17,** 577.

(37) VOHWINKEL, K. H.: Radiobiologische Untersuchungen an Lens Esculenta, Zugleich ein Beitrag zur Dosimetrie des Radiums in der Dermatotherapie. Strahlentherapie, 1932, **43,** 9–42.

(38) WINTZ, H., and RUMP, W.: Biologische Wirkungen Verschiedener Röntgenstrahlenqualitäten. Strahlentherapie, 1926, **22,** 451.

(39) WYCKOFF, R. W. G.: The Killing of Colon Bacilli by X-rays of Different Wave Lengths. Jour. Exper. Med., November, 1930, **52,** 769–780.

(40) ZIRKLE, R. E., ABBERSOLD, P. C., and DEMPSTER, E. R.: The Relative Biological Effectiveness of Fast Neutrons and X-rays upon Different Organisms. Am. Jour. Cancer, March, 1937, **29,** 556–562.

(41) ZUPPINGER, A.: Radiobiologische Untersuchungen an Ascariseiern. Strahlentherapie, 1928, **28,** 639–758.

BENZEDRINE SULPHATE

ITS EFFECTS ON THE MOTOR FUNCTION OF THE DIGESTIVE TRACT, ON GASTRIC ACIDITY, AND ON EVACUATION OF THE BILIARY SYSTEM[1]

By OPIE NORRIS SMITH, M.D., *and* GEORGE W. CHAMBERLIN, M.D., *Philadelphia*

From the Gastro-intestinal Section of the Medical Clinic and the Department of Radiology, Hospital of the University of Pennsylvania

BENZEDRINE (beta-phenylisopropylamine or benzyl methyl carbinamine), one of the sympathomimetic amines structurally related to ephedrine and epinephrine, has recently been the subject of considerable interest. Because of its volatility and of its constrictive action on the nasal mucosa, it has been proved of value in the treatment of rhinological affections (1). Its stimulating effect on the central nervous system has led to its use, as the sulphate, in the treatment of narcolepsy and of certain depressed and fatigue states (2). Myerson and Ritvo (3), furthermore, have claimed that the sulphate, by its effect on smooth muscle, relaxes spasm of the gastro-intestinal tract and so aids in the roentgen diagnosis and in the treatment of certain digestive disturbances. Myerson, Rinkel, and Dameshek (4) have reported that it also markedly increases the acid secretion of the stomach.

This investigation was undertaken with the view of studying, by roentgen examination and by intubation of the stomach and duodenum, certain effects of benzedrine sulphate, in safe dosage, on the gastro-intestinal tract, both in normal subjects and in hospital patients. Inasmuch as the results in some respects are in agreement, but in others are at variance, with those of previous workers it is believed that they deserve consideration.

ROENTGEN STUDIES

The effect of benzedrine sulphate upon the gastro-intestinal tract was studied roentgenologically in 28 subjects. These were grouped as follows:

Type of Subject		Number of Subjects
Normal (students)		4
Duodenal ulcer	Acute	6
	Chronic	4
"Spastic duodenum"		3
Abnormal colon	Spastic	6
	Smooth	2
Miscellaneous		3

Technic.—A barium-and-water mixture consisting of five ounces of barium and five fluid ounces of water was orally administered for the study of the stomach and small intestine and the entire examination was conducted under fluoroscopic control, with interval roentgenograms as indicated. Benzedrine sulphate, usually in a dosage of 20 mg., was given orally in the early part of the study, but later, in order to avoid delay in absorption, by subcutaneous injection. In each of the normal subjects and in some of the patients, a control examination preceded the benzedrine study. All of the patients having duodenal ulcer or duodenal spasm were first studied fluoroscopically without the drug. When, after sufficient time and manipulation, the duodenum could not be filled, 20 mg. of the benzedrine sulphate was given subcutaneously and the fluoroscopic examination continued. In some of the colon cases, the drug was given during the administration of the barium enema, in others it was given after the colon had been filled.

Normal Group.—The results in the four subjects of this group were almost identical. Very little effect on gastric peristalsis

[1] Aided by a grant from the Smith, Kline, and French Laboratories.

Fig. 1-*A*. Fig. 1-*B*.

Fig. 1-*A*. Control study in normal subject.
Fig. 1-*B*. Same subject after administration of benzedrine. Note the gastric residue and delayed small intestinal motility. These films were made at comparable times after the barium was ingested.

was noted. The average time for peristalsis to begin after ingestion of the barium was one minute without benzedrine sulphate and slightly less than one minute with it. The depth and speed of the peristaltic contractions were not appreciably altered. Under control conditions, the duodenal cap filled three minutes, on the average, after ingestion of the barium mixture, and slightly later when benzedrine sulphate had been given. The gastric emptying time in the four subjects was prolonged by 38 minutes, one hour 15 minutes, two hours, and four hours 30 minutes, respectively. The drug produced definite changes in the appearance of the small intestine. In every case the motility was delayed, and in three cases peristaltic rushes with some to-and-fro regurgitation were seen. Under control conditions, the barium reached the cecum in two hours 30 minutes on the average; and after benzedrine sulphate in five hours 45 minutes (Fig. 1). There was also an increase in the time necessary for the small intestine to become empty: under control conditions, the average time was seven hours, as compared to approximately ten hours with the benzedrine sulphate. Changes in the colonic motility were not definite. In one subject there was some delay in the passage of the oral meal through the colon, but this observation was not confirmed in the others.

Duodenal Ulcer Cases.—Six cases of acute and four of chronic duodenal ulcer were examined. Relaxation of the duodenal bulb followed the administration of benzedrine sulphate in all of the acute cases, thus rendering definite help in demonstrating the ulcer crater (Fig. 2). None of the four chronic cases showed the degree of relaxation seen in the acute group, as would be expected from the nature of the lesion. We believe, however, that benzedrine sulphate is of definite diagnostic aid in certain patients of this type.

Diminution of peristalsis and motor activity of the stomach occurred in three patients within from eight to ten minutes after administration of the drug. When two of these were re-examined one day later under control conditions, peristalsis did not diminish during a 15-minute period of observation. The third patient showed on the following day considerable non-

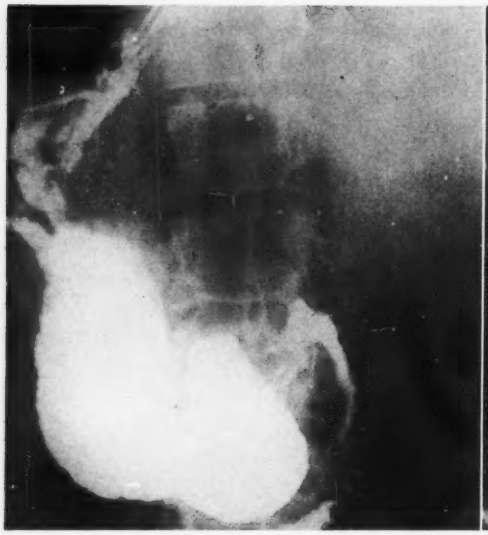


Fig. 2-*A*. Duodenal ulcer before administration of benzedrine.

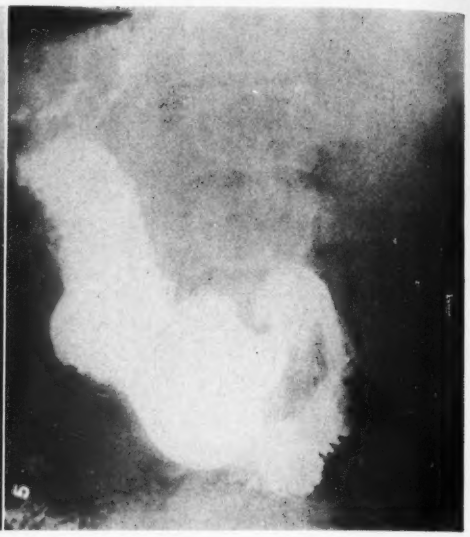


Fig. 2-*B*. Same patient after the injection of 20 mgm. of benzedrine subcutaneously.

opaque residue in an atonic stomach and complained of weakness and nausea. Four minutes after benzedrine sulphate was given, peristalsis became active and the stomach began to empty. He then volunteered the information that the nausea and weakness had lessened. This unexpected observation was made in one other case of an atonic stomach.

In four of the ulcer patients, the gastric emptying time and the small intestinal motility were delayed after the use of benzedrine sulphate. The remaining six were not studied in this respect.

"*Spastic Duodenum*" *Cases*.—The roentgen diagnosis of "spastic duodenum" is subject to considerable error, since the caliber of the duodenum is determined, in part, by gastric motility and also, in part, by the size of the bolus of barium mixture passing through it. We have employed the term in those instances in which gastric motility was delayed or the bolus passing through the duodenum was small. In none of the three cases observed in the present study was an organic cause for the spasm evident. Careful fluoroscopic study failed at first to visualize the duodenum, but almost immediately after the parenteral administration of benzedrine sulphate prompt filling of the duodenum occurred. Since the number of cases observed was small, these results are suggestive but not conclusive.

Colon Cases.—It is necessary to distinguish clearly between the spastic and the smooth colon. The former may show marked irregularity of the contour of the bowel; the haustrations may be more numerous than usual (Fig. 3), or the entire colon may be without definite haustral markings. Under these conditions the injection of the barium mixture frequently causes intense discomfort and, fluoroscopically, a portion of the colon can be seen to contract and expel its contents into a more distal part. In six cases of this spastic type, benzedrine sulphate produced almost immediate relaxation of the colon and relief of pain, so that the barium injection could be continued without further difficulty.

Considered roentgenologically, the smooth, or non-irritable, colon is one having an unusual lack of haustral markings. In the two such cases, we observed no

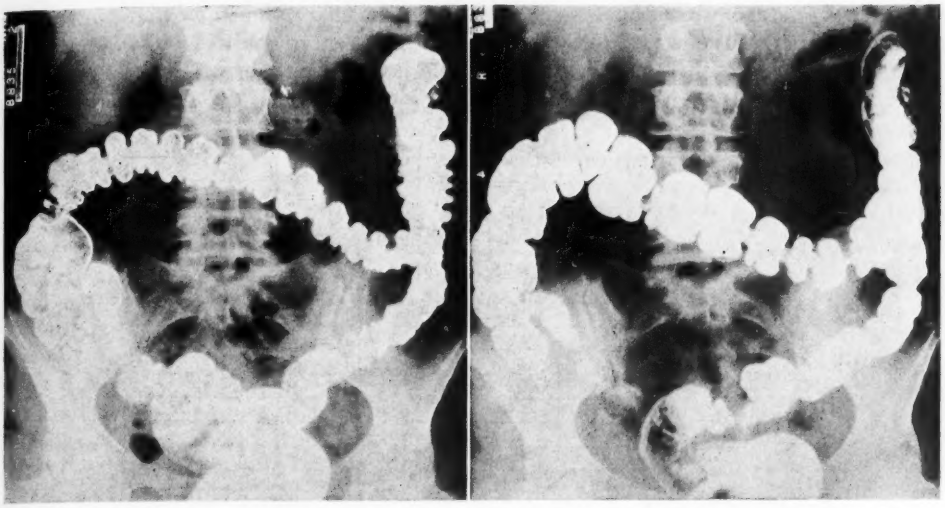


Fig. 3-*A*. Spastic colon before use of benzedrine sulphate. Fig. 3-*B*. Same patient 15 minutes after the injection of benzedrine.

change in the caliber of the lumen or in the appearance of the haustral markings after the use of benzedrine sulphate.

Miscellaneous Cases.—This group consisted of one case of pulmonary tuberculosis with small intestinal and colonic hypermotility, one of gastro-intestinal hypermotility apparently due to an acute gastro-intestinal infection of undetermined type, and one of pronounced hypomotility of the small intestine associated with a carcinoma of the head of the pancreas. In each instance delay in gastric and small intestinal motility occurred after benzedrine sulphate. In one patient with a severe diarrhea, barium appeared in the descending colon 30 minutes after its ingestion. He was then given 10 mg. of benzedrine sulphate three times daily for several days and subsequently re-examined, at which time the head of the barium column did not reach the descending colon until 4 hours and 20 minutes after ingestion of the opaque meal.

GASTRIC SECRETION

Six healthy medical students and seven ambulant patients hospitalized for various medical conditions were subjected to duplicate gastric analyses with identical technic except for the administration of benzedrine sulphate before one of the tests: 30 mg. were ingested 45 minutes before the test meal in three instances; and 20 mg. were dissolved in the gruel given to each of the remaining ten subjects.

Technic.—The analyses were performed in the early morning, the subjects having had no food since supper and no liquids since bedtime. A small-bore rubber tube with metal bucket was passed, the gastric contents aspirated, and 300 c.c. of oatmeal gruel swallowed. Beginning a half-hour after the test meal, 10 c.c. samples of the gastric contents were withdrawn every 15 minutes until 90 minutes had elapsed, at which time the stomach was entirely emptied. One c.c. samples of each specimen were diluted with distilled water, and promptly titrated with N/50 sodium hydroxide, using Topfer's reagent and phenolphthalein as indicators. The acidity values were recorded in conventional units. Histamine was not given.

Taken as a single group, the 13 subjects showed very slight increase in gastric acidity after benzedrine sulphate. In the hospital patients, the acidity curves showed

insignificant change after the drug. In healthy subjects, there was moderate increase in acidity after the administration of benzedrine sulphate, averaging 16 units after the 30-minute specimen. When the benzedrine sulphate was dissolved in the gruel, variations were rarely appreciable before the 45-minute specimen. The curves for total acid reflected the same general changes as did those for the free hydrochloric acid.

When the drug was administered 45 minutes before the test meal, no constant increase in the acidity of the fasting gastric contents was observed. The average volume of gastric residue at the end of the analysis was virtually identical under control conditions and with benzedrine sulphate.

One normal subject had complete achlorhydria, which was not altered either by histamine or by benzedrine sulphate. In one hospital patient with complete achlorhydria after the gruel meal, a maximum of six units of acid was found after the administration of benzedrine. The effect of histamine in this individual was not determined.

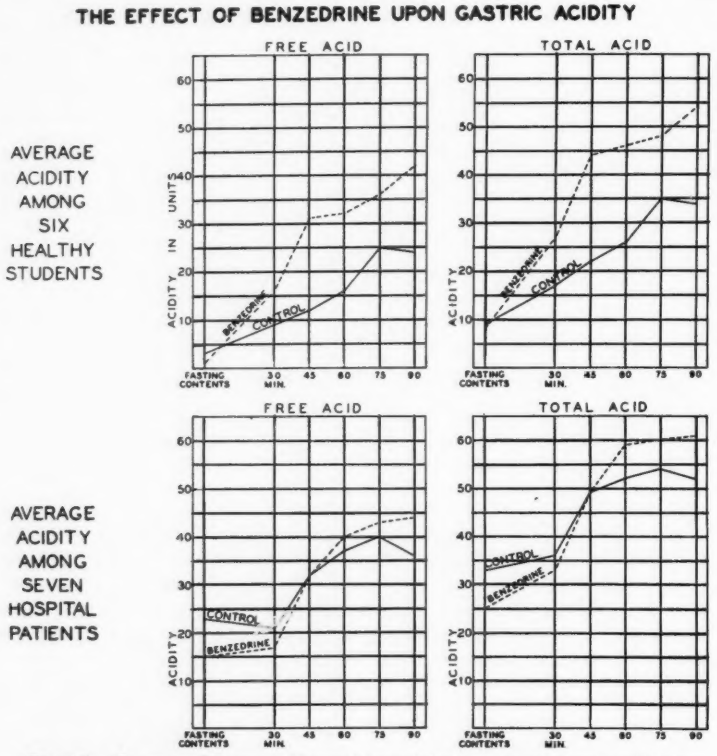


Chart I. Twenty milligrams of benzedrine sulphate orally produced a mild elevation of gastric acidity in healthy medical students, but no significant change in the acidity of convalescent hospital patients. The volume of the gastric residue was not affected.

BILIARY DRAINAGE

In six fasting patients, 20 mg. of benzedrine sulphate dissolved in 10 c.c. of warm water was introduced into the duodenum by tube. During a 30-minute observation period, no drainage from the biliary system was apparent in any case. At the end of this period the introduction of olive oil into the duodenum effected prompt evacuation of the biliary system in each patient. This suggests that 20 mg. of the drug

neither stimulates the musculature of the gall bladder nor inhibits contraction of the sphincter of Oddi, partially confirming the results of Schube *et al.* (6), based upon roentgen observations.

TOXICITY AND UNTOWARD EFFECTS

One of our patients exhibited an alarming reaction several hours after the ingestion of 30 mg. of the drug. This incident occurred early in the course of our study, with the result that subsequently we did not exceed a dose of 20 mg.

Case Report.—A white woman, 36 years of age, who complained of weakness and weight loss, was found to have a moderate secondary anemia, apparently due to bleeding hemorrhoids and menorrhagia. Eight days after admission she was given 10 mg. of benzedrine sulphate without ill effect. Early the next morning, preceding a gastric analysis, 30 mg. of the same drug was administered orally. An hour later her blood pressure had risen from 114/70 to 134/76, while her pulse had dropped from 100 to 76. After another 30 minutes she began to complain of a "hot feeling" and in the late afternoon she lost consciousness and had irregular spasmodic twitchings of the arms for a brief period; subsequently, with return of consciousness, she complained of numbness of the arms and hands and had impairment of pain sense in those parts. Doryl (carbinoylcholine), administered subcutaneously, brought about complete relief within five minutes and her blood pressure promptly dropped to 105/65.

Although the belated appearance of this reaction raises some doubt as to the part played by benzedrine sulphate, nevertheless the character of the symptoms, their prompt alleviation by a choline derivative, and their absence at other times suggest that it was responsible.

Severe headache may follow the ingestion of only 5 mg. of the drug. The blood pressure may rise, although usually little change has been observed with oral doses of less than 30 mg. The central nervous system stimulation effected by benzedrine sulphate in psychiatric patients has been described (5) as resulting in euphoria and elation. Among the normal subjects of our study, however, we found that the not infrequent headache, mental excitement, and sense of nervous tension produced by it did not constitute a "sense of well-being." All reports agree that insomnia usually precludes the use of the drug for from six to eight hours before retiring.

COMMENT

A study of the actions of a drug on the motor functions of the human gastro-intestinal tract is complicated by the fact that it is impossible to eliminate with certainty the various extraneous factors known to influence tone, peristaltic activity, and motility. In this study, therefore, we have regarded as significant only those effects which were so striking as to be unmistakable. Our observations indicate that benzedrine sulphate in doses of 20 mg. has no effect on peristalsis in the stomach of normal tonus. In all of our cases in which we had control studies, the gastric emptying time was prolonged. This observation differs from that of Myerson and Ritvo (3), who state that "the stomach actually empties more rapidly than normal under the influence of the drug." In two of our patients having atonic stomachs peristalsis became active after the use of benzedrine sulphate. This observation requires corroboration.

In the small intestine delay in the motility of the barium mixture occurred after the administration of the drug. Other variations from normal were not striking, and in only an occasional case did the observations indicate increased caliber. Gas in the small intestine was occasionally observed in normals. Fluoroscopically, a moderate amount of to-and-fro churning and an occasional peristaltic rush in the proximal small intestine in three of our normal subjects was observed. Such disturbances are a disadvantage to the radiologist who is interested in a comprehensive study of the motor functions of the gastro-intestinal tract. The routine use of

benzedrine sulphate as a diagnostic aid in gastro-intestinal roentgenology, therefore, is unnecessary and may be confusing. We believe, however, that the drug may be of value in the roentgen examination of certain cases of organic or functional spasm of the duodenum in which the usual methods of examination are inadequate. We have found it useful in relaxing the spastic colon during a barium enema, and it has not only enabled us to fill the colon easily and completely, but also has relieved the patient of much discomfort.

Gastric analysis showed that there was only a slight increase in acidity following the administration of 20 mg. of benzedrine sulphate. When present, the increase appeared to be somewhat greater in the normal individuals than in the hospital cases. Our failure to demonstrate an increase in the acidity of the gastric contents, as reported by Myerson and his coworkers (4), is perhaps due in part to the type of subject used. Our reluctance to equal their larger dosage, however, is doubtless a more important factor in explaining the discrepancy.

Previous workers (6) have found that under certain conditions the gall bladder fails to empty after the administration of benzedrine sulphate. Our results seem to indicate, however, that although it produces no evacuation, it does not interfere subsequently with the usual emptying effect of olive oil.

CONCLUSIONS

On the basis of a study of the gastro-intestinal tract of 28 human subjects by the roentgen ray, of 15 subjects by gastric analysis, and of 6 by duodenal drainage after the administration of from 20 to 30 mg. doses of benzedrine sulphate, the following conclusions as to the action of the drug seem justified:

1. It does not affect peristalsis in the normal stomach, but in three patients with duodenal ulcer it had an inhibitory effect, and in two with gastric atony it had a stimulating effect.

2. It delays the emptying time of the stomach.

3. It delays small intestinal motility.

4. By its relaxing effect on smooth muscle it often is an aid in the roentgen diagnosis of acute and chronic ulcer of the duodenum, of duodenal spasm, and of the spastic colon.

5. It increases gastric acidity to a slight extent in normals, but to an insignificant degree in patients such as we have studied.

6. As indicated by duodenal drainage, it does not stimulate evacuation of the biliary system.

BIBLIOGRAPHY

(1) (*a*) BERTOLET, J. A.: Med. Jour. and Rec., July 20, 1932, **136,** 75, 76.
(*b*) BYRNE, H. V.: New Eng. Jour. Med., Nov. 23, 1933, **209,** 1048–1051.
(*c*) SCARANO, J. A.: Med. Rec., Dec. 5, 1934, **140,** 602–604.
(*d*) WOOD, E. L.: Arch. Otolaryng., May, 1935, **21,** 588–590.
(2) (*a*) PRINZMETAL, M., and BLOOMBERG, W.: Jour. Am. Med. Assn., Dec. 21, 1935, **105,** 2051–2054.
(*b*) MYERSON, A.: Arch. Neurol. and Psychiat., June, 1936, **35,** 1346–1348.
(*c*) ULRICH, H., TRAPP, C. E., and VIGDOFF, B.: Ann. Int. Med., March, 1936, **9,** 1213–1221.
(*d*) DAVIDOFF, E., and REIFENSTEIN, E. C.: Jour. Am. Med. Assn., 1937, **108,** 1770, .
(3) MYERSON, A., and RITVO, M.: Jour. Am. Med. Assn., July 4, 1936, **107,** 24–26.
(4) MYERSON, A., RINKEL, M., and DAMESHEK, W.: New Eng. Jour. Med., Nov. 26, 1936, **215,** 1005–1013.
(5) PEOPLES, S. A., and GUTTMANN, E.: Lancet, May 16, 1936, **1,** 1107–1109.
(6) SCHUBE, P. G., RITVO, M., MYERSON, A., and LAMBERT, R.: New Eng. Jour. Med., 1937, **216,** 694.

THE EFFECT OF LARD OIL, SESAME OIL, ACACIA, RETENE, AND 1:2:5:6 DIBENZANTHRACENE ON CERTAIN ORGANS AND A TRANSPLANTABLE RAT SARCOMA IN ANIMALS OF PURE BREED

By JOSEPH A. POLLIA, M.D., *Los Angeles, Calif.*

From the Frank H. Boyer Foundation

IT has been found by Haddow (1), Haddow and Robinson (2), and Scott (3) that injections of certain carcinogenic hydrocarbons inhibit the growth of Jensen or Walker rat tumors, or of young rats without producing ill health or "undoubtedly significant changes" in various organs. However, it is well known that sickness in animals invariably inhibits tumor development.

The importance of Haddow's (1) observation and the possible application to cancer treatment led to the experiments reported in this paper.

The effect of the compounds was studied upon a tumor, B, No. 2, propagated in this laboratory from a spontaneous uterine growth, probably a sarcoma, in an old female, and transplanted into pure bred, young adult rats (Fig. 1). It yields 100 per cent takes and, to date, without a single instance of spontaneous regression, but when the tumor is inoculated into another breed the yield immediately drops to about 30 per cent.

Transplantation of the Tumor.—All tumors are transplanted in the form of a suspension of cells produced by grinding the tumor in a Fischer embryo juice press that contains 20 and 80 mesh metal cloth strainers, respectively, and then diluting it with Tyrode's solution to the required concentrations.

Compounds Tested.—The materials tested were (1) Light's London, England, 1:2:5:6 dibenzanthracene; (2) Eastman Kodak Company's Retene, $C_{18}H_{18}$, which contains the phenanthrene nucleus, but is not related to the sterols, and as yet without indications of carcinogenic effect; (3) lard oil; (4) household and distilled sesame oil; (5) acacia, and (6) Belgian Chemical Company's 3:4 benzpyrene which had to be abandoned during the preliminary experiments because of great toxicity and 100 per cent mortality.

The two hydrocarbons were given as colloidal suspensions and sesame oil solutions. It was found that lard oil took up four times as much retene as sesame oil, but the dibenzanthracene dissolved by both oils was the same. The lard oil, prepared according to Burrows *et al.* (4), when injected intraperitoneally produced so much organized material that it was distilled at 35° C., but since this did not remedy the difficulty, sesame oil was finally selected for all the reported experiments.

The Sesame Oils.—Two brands of sesame oil were employed: (1) a pure distilled brand, furnished by the Eastman Kodak Company, through the courtesy of Dr. Mees, and (2) the household variety.

Sterilization of Materials.—The solutions in lard and sesame oil were sterilized in a household gas hot air oven at 150° C. for one hour. Colloidal solutions prepared according to Berenblum (5) were autoclaved for 20 minutes at a steam pressure of 15 pounds. These methods caused no perceptible break-down of the hydrocarbons or of the oils which could be detected by any change in color or odor. A total of 250 animals was used, 96 in preliminary experiments, to standardize the technic, and the 154 animals in the work reported here. Since both the preliminary and final experiments showed that retene and 1:2:5:6 dibenzanthracene had definitely inhibited tumor B, No. 2, the first reported experiment was to determine if the Arndt-Schulz law, that weak stimuli increase while strong ones inhibit physiological activity, could be elicited on B, No. 2, with minute doses of carcinogenic compounds.

Experiment 1.—The effect of *dilute* col-

loidal solutions of retene and 1:2:5:6 dibenzanthracene. Series of April 14, 1937. Twenty-four animals were injected intraperitoneally five times with 5 c.c. of solution. Table I gives the final results.

TABLE I.—AVERAGE WEIGHTS

Treatment	Tumor	Percentage of Variation
Untreated	42.4 gm.	100.0
5 times 5 c.c. 1 per cent acacia	33.6 gm.	79.2
5 times 5 c.c. of retene 1 mg.	35.5 gm.	83.2
5 times 5 c.c. of dibenz. 2.25 mg.	29.9 gm.	70.3

Therefore, it is suggested that small doses of these hydrocarbons and acacia do not accelerate but inhibit the growth of B, No. 2.

Experiment 2.—Since small doses of 1:2:5:6 dibenzanthracene and retene inhibit instead of accelerate the growth, in the following experiment concentrated colloidal solutions were used. The effect of *concentrated* colloidal solutions of hydrocarbons. Series of April 21, 1937. Thirty-three animals were treated with three intraperitoneal injections of 5 c.c. each.

This experiment shows an unexplained increased growth in the animals which received acacia and retene, but a decrease by 22.9 per cent in those given 1:2:5:6 dibenzanthracene. Autopsy showed no organic changes in the untreated controls or the acacia animals, but there was present an increase in the connective tissue around the liver, ascites and deposits of retene in one of the eight rats, while deposits of 1:2:5:6 dibenzanthracene in the peritoneal cavity and ascites were present in four rats. The kidneys and lungs were the same as those of the untreated controls.

TABLE II.—AVERAGE WEIGHTS

Treatment	Animal	Tumor	Percentage of Tumor Variation
Untreated (8 rats)	114.0 gm.	16.2 gm.	100.0
15 c.c. 6 per cent acacia (8 rats)	130.0 gm.	19.4 gm.	119.7
3.98 mg. retene in 15 c.c. of sol. (8 rats)	123.0 gm.	18.4 gm.	113.5
4.0 mg. 1:2:5:6 in 15 c.c. of sol. (9 rats)	132.0 gm.	12.5 gm.	77.1

The next experiment deals with household sesame oil solutions, in which the rats were injected intraperitoneally with one dose of 5 c.c.

Experiment 3.—The effect of household sesame oil solutions. Series of April 22, 1937. Twenty animals.

TABLE III.—AVERAGE WEIGHTS

Treatment	Animal	Tumor	Percentage of Tumor Variation
Untreated	119.6 gm.	30.7 gm.	100.0
5 c.c. household sesame oil	111.0 gm.	30.0 gm.	97.7
600 mgm. of retene 5 c.c. S.O.	105.0 gm.	14.6 gm.	47.5
50 mgm. 1:2:5:6 dibenz. in 5 c.c. S.O.	123.5 gm.	10.7 gm.	32.2

TABLE IV.—AUTOPSY FINDINGS

Organs	Untreated	Sesame Oil	Retene	1:2:5:6 Dibenzanthracene
Lungs	Normal	Metastasis (1)	Normal	Normal
Liver	Normal	Oil organized under surface (4)	Material organized (4); metastasis (1)	Material organized (5); swelling (1)
Kidney	Normal	Normal	Normal	Normal
Spleen	Normal	Normal	Normal	Normal
Peritoneum	Normal	Oil organized (4)	Material organized in nodules (4); Free oil (3); Metastasis (1)	Free oil (3); ascites

Number of rats in each group showing pathologic change is indicated by the numeral.

There was practically no variation in the average tumor weight between the untreated and sesame oil animals. The greatest amount of inhibition was found, as expected, with dibenzanthracene; however, the effect of retene is remarkable since it is unrelated to the carcinogenic compounds except that it is a phenanthrene derivative. The considerable damage to various organs is summarized in Table IV.

Experiment 4.—The effect of household sesame oil solutions. Series of April 29, 1937. Twenty animals.

TABLE V.—AVERAGE WEIGHTS

Treatment	Animal	Tumor	Percentage of Tumor Variation
Untreated	143.6 gm.	31.4 gm.	100.0
5 c.c. oil	130.0 gm.	29.7 gm.	94.6
600 mgm. retene	105.5 gm.	18.8 gm.	59.9
50 mgm. 1:2:5:6 dibenzanthracene	126.6 gm.	8.4 gm.	27.1

Experiment 4 is a duplicate of Experiment 3. Four groups of five rats each were inoculated with B, No. 2, tumor and given the same treatment. Comparison of the weights of the tumors in the controls and treated animals shows very little variation in the two experiments.

thracene had an average weight decrease of 45.8 per cent as compared with the 93.4 per cent of those receiving sesame oil and

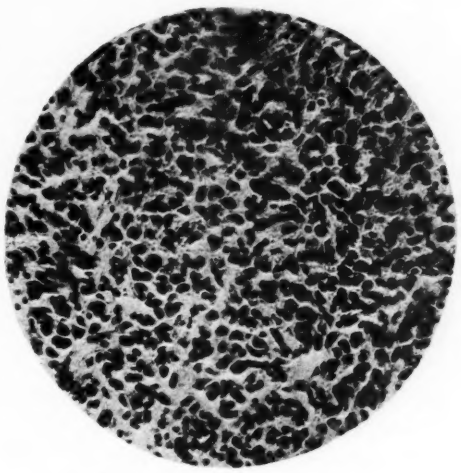


Fig. 1. Rat sarcoma B, No. 2.

96.5 per cent of those which had gotten 10 mgm. of the non-carcinogenic pyrene. If, on the contrary, the inhibitions were due to a specific effect, tumors developing from small inocula should be more susceptible than those from larger ones. Therefore the following experiment was performed. Sixteen rats weighing about 125 to 150 grams were inoculated with B, No. 2, suspension

TABLE VI.—AUTOPSY FINDINGS IN EXPERIMENT 4

Treatment	Liver	Kidneys	Spleen	Peritoneum
Untreated	Metastasis (1)	Normal	Normal	Normal
Sesame oil	Swollen (5)	Normal	Normal	Acetone odor (all); some milky fluid (all); free oil (1)
Retene	Deposits (all); swollen (all)	Normal	Deposits (all)	Material organized in nodules (all); free oil (all); fluid (all); ascites (all)
1:2:5:6	Deposits (3)	Inflammation (?) (1)	Deposits (3)	Free oil (3); ascites (3); fibrous adhesions (1)

The lungs were normal in all of this series.

Is the inhibition just discussed due to a specific effect on the tumor cell or to an effect on the whole animal? There is some evidence in favor of the latter possibility in the observation of Scott, who has shown that rats treated with 1:2:5:6 dibenzan- in quantities 0.01 c.c. to 0.0001 c.c. in the right axilla and hypochondrium, and 0.001 and 0.00001 c.c. in the left axilla and hypochondrium. The following day eight were given 5 c.c. of colloidal solution of 1:2:5:6 dibenzanthracene intraperitoneally which

contained 2.5 mgm. to insure the maximum absorption. Fourteen days later they were sacrificed. Table VII shows in a most striking manner that the dibenzanthracene-treated animals had tumors which were 45.2 per cent less in weight than the controls, but the number of takes with 0.00001 c.c. were three for the untreated and also three for the treated. This suggests that the inhibition is a general and not a specific effect. These multiple inoculations of varying sizes were done several times with the same results.

Again one notes pathologic effects in the abdomen, deposits of the hydrocarbon on the abdominal organs, death of embryos, fluid in the peritoneal cavity, adhesions and swelling of the liver (Table VIII).

Experiment 5.—The effect of concentrated colloidal solutions of 1:2:5:6 dibenzanthracene on the growths from various volumes of tumor suspensions. Series of May 5, 1937. Sixteen animals. Multiple tumors from 0.01 c.c., 0.001 c.c., 0.0001 c.c., 0.00001 c.c. of suspension.

Up to this time there had been considerable doubt, in view of Haddow's careful work, that the changes observed in the organs played any part in the inhibition of tumor growth. However, it was gradually becoming inescapable that there were far more pathologic alterations in the author's animals than would be expected since it is stated that no evidence was found to suggest that the inhibition obtained in Haddow's experiments was due to a general toxic effect. Therefore, Experiment 6 was planned so that the blood, thymus, lungs, heart, liver, spleen, kidneys, and genitalia could be studied carefully, grossly as well as microscopically, to determine whether the extent of these pathologic conditions was sufficient to be responsible for part of the lack of growth in the tumors of treated animals. In the dibenzanthracene rats, the thymus had been difficult to find, which seemed unusual since in the controls the gland was of a normal size. In the same manner already stated, four groups of four rats each were inoculated with 0.01 c.c., 0.001 c.c., 0.0001 c.c., and 0.00001 c.c. of tumor suspension B, No. 2. The following day one group was set aside as untreated controls and the remaining three were given 5 c.c. of sesame oil, and retene and dibenzanthracene in oil solution, intra-

TABLE VII.—AVERAGE TUMOR WEIGHTS IN GRAMS

Treatment	Animal	0.01 c.c.	0.001 c.c.	0.0001 c.c.	0.00001 c.c.	Percentage Variation of Total Tumor Tissue
Untreated	157	7.3	1.6	0.4	Three takes too small to weigh	100.0
2.5 mg. 1:2:5:6 dibenzanthracene	152	3.4	0.7	0.1	Three takes too small to weigh	45.2

TABLE VIII.—AUTOPSY FINDINGS: NUMBER OF RATS IN EACH GROUP SHOWING PATHOLOGIC CHANGE

Treatment	Lungs	Liver	Kidney	Peritoneum	Spleen	Miscellaneous
Untreated	Negative	Negative	Negative	Negative	Negative	Normal embryos (1)
1:2:5:6 dibenzanthracene	Negative	Deposits (5); swollen (1)	Negative	Fluid (all); adhesions (1)	Deposits (5)	Abnormal embryos: dead (1); pallor (2)

Experiment 6.—The effect of distilled sesame oil solutions of retene and 1:2:5:6 dibenzanthracene on Tumor B, No. 2, series of June 4, 1937. Sixteen animals. Multiple tumors from 0.01 c.c. and 0.001 c.c. of tumor tissue.

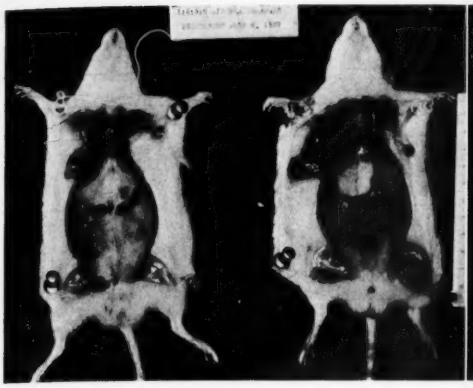


Fig. 2.

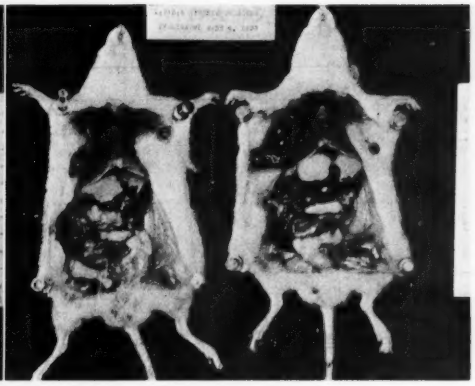


Fig. 3.

Fig. 2. Distention of the abdominal cavity by fluid from the injection of sesame oil solution of 1:2:5:6 dibenzanthracene in Experiment 6.

Fig. 3. Deposits of 1:2:5:6 dibenzanthracene in the abdominal cavity of the animals shown in Figure 2.

peritoneally. Fourteen days later all 16 were sacrificed, examined, and the above mentioned organs removed and fixed in 10 per cent formaldehyde. Frozen sections were made for microscopic study, and stained with hematoxylin-eosin. As will be seen in Table IX, the same effects on tumor size were found as in the preceding experiments.

TABLE IX.—AVERAGE WEIGHTS

Treatment	Animal	Tumor	Percentage of Tumor Variation
Untreated	138.9 gm.	14.7 gm.	100.0
5 c.c. sesame	117.0 gm.	7.5 gm.	51.0
600 mg. retene	116.0 gm.	4.5 gm.	30.6
50 mg. dibenz.	124.0 gm.	2.6 gm.	17.6

Except that the sesame oil produced a marked inhibition—a difference of 49.0 per cent which has not been observed in Experiments 3 and 4—and the figures for retene being only slightly less than for sesame oil, the expected variations were noted, with dibenzanthracene again showing the greatest inhibition.

The blood counts taken immediately before the experiment was terminated, when compared with the count obtained before treatment began showed a slight decrease in hemoglobin for the untreated animals, while sesame oil, retene, and 1:2:5:6 dibenzanthracene seemed to keep it within the starting limits. Since anemia is one of the consistent effects of tumor B, No. 2, it can be said that those materials had a slight "salutatory" effect. No comment can be made on the red cells as the variation is not sufficient. A very interesting change took place in the leukocyte count, which increased 28.3 per cent for the group of untreated, but showed a decrease in the sesame oil, retene, and but slightly or negligibly in dibenzanthracene. The percentage of variation in the polymorphonuclear group was the most striking of the blood effects, for here the untreated controls gave 183.1 per cent increase, sesame 36.6 per cent, dibenzanthracene 75.4 per cent, but an enormous increase for retene, which yielded 451.6 per cent. The autopsy findings were similar to those found in the previous experiments with sesame oil solutions and are summarized in Table X.

Microscopical sections of liver, peritoneum, pancreas, peripancreatic content. Tissue, kidneys, lungs, spleen show in each animal the presence of a variety of inflammatory changes correlated in detail in Table XI.

Distilled sesame oil. Series of June 4, 1937. Sixteen animals. (Table X.)

TABLE X.—TABLE OF AUTOPSY FINDINGS: NUMBER OF RATS IN EACH GROUP SHOWING PATHOLOGIC CHANGE

Treatment	Lungs	Liver	Kidney	Peritoneum	Spleen	Thymus
Untreated	Negative	Negative	Negative	Negative	Negative	Negative
Sesame oil	Negative	Swollen (4); deposits (4)	Negative	Free oily solution (4); acetone odor (4); some organization of oil (4)	Deposits (4)	Negative
Retene	Negative	Swollen (3)	Negative	Material organized in nodules (3); oily fluid, 0.5 to 1 c.c. (4)	Negative	Atrophy (4)
1:2:5:6	Negative	Deposits (4) (Fig. 3); swollen (3)	Negative	Ascites (4) (Fig. 2); serosanguinous, oily fluid, 6.5 to 13 c.c. (4)	Deposits (4)	Atrophy (4)

TABLE XI.—TABLE OF MICROSCOPICAL FINDINGS

Organs	Liver	Peritoneum	Pancreas	Peripancreatic Con. Tissue	Kidneys	Lungs	Spleen
Untreated	Negative	Negative	Negative	Negative	Negative	Slight pneumonic changes	Negative
5 c.c. sesame oil	Hyperemia	Marked cell. infiltration (Fig. 4)	Necrosis	Cellular infiltration	Slight change (?)	Definite extravasation of blood	Change in hematopoietic tissue
600 mg. retene	Mod. no. areas focal necrosis	Thickening (?); edema	Necrosis	Marked cellular infiltration	Slight change (?)	Definite extravasation of blood	Change in hematopoietic tissue
50 mg. 1:2:5:6 dibenzanthracene	Extensive focal necrosis (Fig. 5)	Atrophy with cellular infiltration	Necrosis (Fig. 5)	Marked cellular infiltration	Slight change (?)	Definite extravasation of blood	Change in hematopoietic tissue

Heart muscle and the tumor B, No. 2, apparently were in no way affected by the treatment given the animals.

Distilled sesame oil solutions. Series of June 7, 1937. Sixteen animals. (Table XI.)

Experiment 7.—The effect of concentrated colloidal solutions, 2 c.c. intracardiac injection. Series of June 7, 1937. Sixteen animals.

The visible deposits of hydrocarbons, described above, indicated that dibenzanthracene and retene in sesame oil are poorly absorbed, since such a large amount is precipitated or organized. Concentrated colloidal solutions seem to suffer the same fate, as considerable precipitation also occurs, if the amount injected is taken into consideration. Therefore, the only way in which complete entrance of the dose in the body can be assured seems to be by injection of the colloidal solutions of the compounds into the blood stream.

Accordingly four groups of four rats each, weighing about 100 grams, were inoculated in the manner described, with 0.01 c.c., 0.001 c.c., 0.0001 c.c., and 0.00001 c.c. of suspension of tumor B, No. 2, and the next day three groups received intracardiac injections under ether of 2 c.c. of acacia, 2 c.c. of colloidal retene solution containing 0.88 mg., and 2 c.c. of colloidal solution of 1:2:5:6 dibenzanthracene containing 1.0 mg. The untreated controls were also anesthetized and punctured, but did not receive any injection.

This Table XII shows the same tendency to inhibition in the growth of the tumor as has already been noted in the intraperitoneal injections, but to a much less degree, which may be accounted for by the small dose of the retene and 1:2:5:6 di-

benzanthracene. From the degree of pathologic change in the liver and the relative freedom from trouble in the kidneys and spleen, it would seem that liver damage may be one of the factors in the inhibition of tumor growth.

The autopsy findings except for lung metastases in one animal of the retene and acacia group were negative for all organs examined, as indicated in Table XIII.

Concentrated colloidal solutions, 2 c.c. intracardiac injection. Series of June 7, 1937. Sixteen animals. (Table XIII.)

Except for the accidental occurrence of

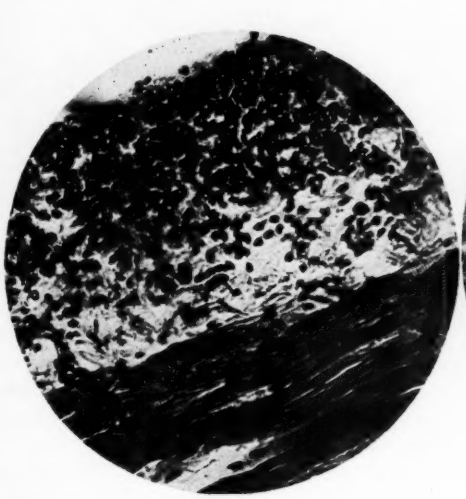


Fig. 4.

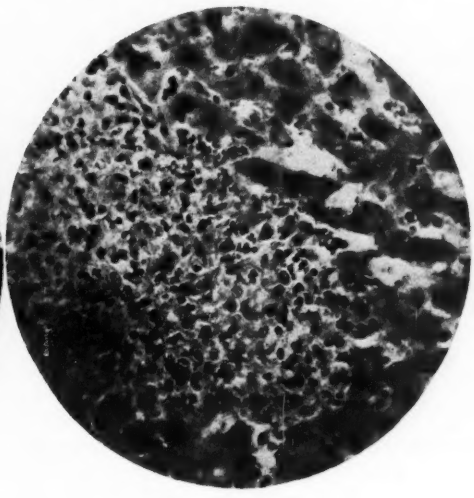


Fig. 5.

Fig. 4. Intense cellular reaction of the peritoneal coat in the animals injected with sterilized distilled sesame oil (450 × hematoxylin-eosin).

Fig. 5. Extensive focal necrosis of the liver from distilled sesame oil solutions of 1:2:5:6 dibenzanthracene (450 × hematoxylin-eosin).

TABLE XII.—AVERAGE WEIGHTS

Treatment	Animal	Spleen	Tumor	Percentage of Tumor Variation
Untreated	147.4 gm.	0.7 gm.	12.0 gm.	100.0
2 c.c. of 6 per cent acacia	151.9 gm.	0.8 gm.	11.2 gm.	93.3
2 c.c. retene sol., 0.88 mg.	126.0 gm.	0.7 gm.	8.8 gm.	73.2
2 c.c. 1:2:5:6 dibenzanthracene, 1.0 mg.	151.0 gm.	0.6 gm.	8.4 gm.	70.5

TABLE XIII.—TABLE OF AUTOPSY FINDINGS: NUMBER OF RATS IN EACH GROUP SHOWING PATHOLOGIC CHANGE

Treatment	Lungs	Liver	Kidneys	Peritoneum	Spleen
Untreated	Negative	Negative	Negative	Negative	Negative
Acacia	Metastasis (1)	Negative	Negative	Negative	Negative
Retene	Metastasis (1)	Negative	Negative	Negative	Negative
1:2:5:6 dibenzanthracene	Negative	Negative	Negative	Negative	Negative

lung metastases in the acacia- and retene-injected animals, there were no gross abnormalities observed in these post-mortem examinations.

COMMENTS ON PHOTOMICROGRAPHS

Microscopic sections were made of the liver, kidney, and tumor in Experiment 7. The liver suffered damage in both the retene and dibenzanthracene animals. Although they were not of the same degree as those seen in sesame oil solutions, still they were consistent with the pathologic effects of the same hydrocarbons in the sesame oil solutions.

SUPPLEMENT

Haddow and Robinson (2), Haddow (1), Scott and Scott (6) described a method of preparing their sesame oil solutions different from that used by the author. They heat their solutions to 100° C., and in all but one exception use 0.5 per cent of 1:2:5:6 dibenzanthracene in contrast to heating at 150° C. for one hour of a 1 per cent solution. Scott notes that the systemic absorption of 1:2:5:6 dibenzanthracene is probably less at 1 per cent because of precipitation, and used it only in one experiment. In addition, the authors cited gave two injections, using about twice as much, and also stated that the sterilization process serves to dissolve the dibenzanthracene, but did not say how long the heat is applied.

All of the dibenzanthracene solutions used in the preceding experiments were 1 per cent, and heated at 150° C., for one hour, but this treatment was not sufficient to dissolve the material entirely and on cooling to body temperature, a considerable portion crystallized out. It is possible that if these oils were heated too long in the presence of air, and oxidation had taken place, with the production of irritating substances such as aldehydes, that would explain the varying degrees of peritoneal reaction found above, although it would not account for the definite liver changes seen when the small doses of retene, and 1:2:5:6 dibenzanthracene were injected into the rat's blood stream. Therefore in Experiment 8, the materials were prepared in accordance to the published technic.

Solutions of 0.5 per cent and 1.0 per cent of Eastman Kodak Company's 1:2:5:6 dibenzanthracene, M.P. 258–260° C., were prepared, corked with cotton plugs, placed in the hot air oven and heated to 100° C. After two hours, aided by frequent shaking and mashing with a sterile glass rod, the material in the 0.5 per cent showed complete solution except for one tiny crystal, but in the 1.0 per cent it did not completely dissolve even after two and one-half hours. Then it was taken out, but when the two concentrations were allowed to cool to 37° C., a considerable number of crystals reappeared, which caused both fluids to become opalescent.

The following day three Wistar rats, average weight 135 grams, three of mixed breed, average weight 100 grams, and three pure strain, average weight 90 grams, were separated into three groups, consisting of one Wistar, one mixed, and one pure strain. The first group received two doses of 5 c.c. each of 0.5 per cent solution of 1:2:5:6 dibenzanthracene on two consecutive days, and the second group was given two doses of 5 c.c. each, also on consecutive days of the 1.0 per cent solution heated to 100° C. for two and one-half hours. The third group was used for the sesame oil treatment. In order to eliminate the possible presence of injurious products from heating, 30 c.c. of distilled sesame oil was withdrawn from the lower third of the container with sterile technic in such a way as to insure at least the absence of mass aerobic contamination. The animals were injected intraperitoneally with two doses of 5 c.c. each of this unheated oil on two consecutive days. Twenty-one days later, all nine animals were sacrificed. The autopsy findings described in Table XIV show that the lesions produced by unheated sterile sesame oil and by a solution of dibenzanthracene, made in accordance with the published technic, were simi-

lar to those observed in the previous experiments in which sesame oil and its solutions of retene and 1:2:5:6 dibenzanthracene were used, made in accordance with the oral instructions. Therefore, the pronounced general toxic effects in the author's animals could not be due to the difference in preparation, concentration, and sterilization of the materials. The volume used in the published technic was twice that employed in the previous experiments herein described. The injection of this amount in this experiment caused proportionately greater lesions, deposits of hydrocarbon, sero-sanguinous fluid, and bright yellow oil to appear in aspirated quantities of 4.0–13.5 c.c. However, one very interesting observation concerned the unheated sterile sesame oil. The entire amount had been converted into a milky emulsion the consistency of gruel, one probable stage in the changes undergone by this oil in the peritoneal cavity.

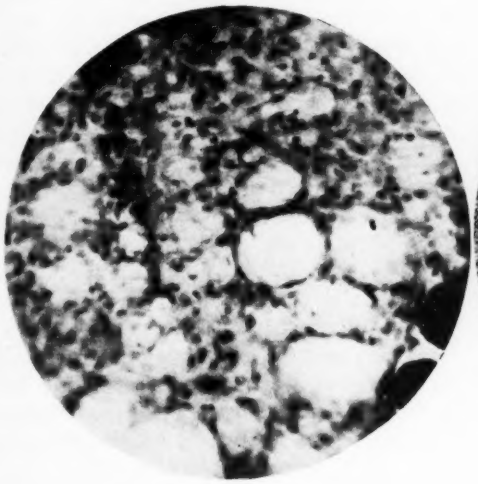


Fig. 6.

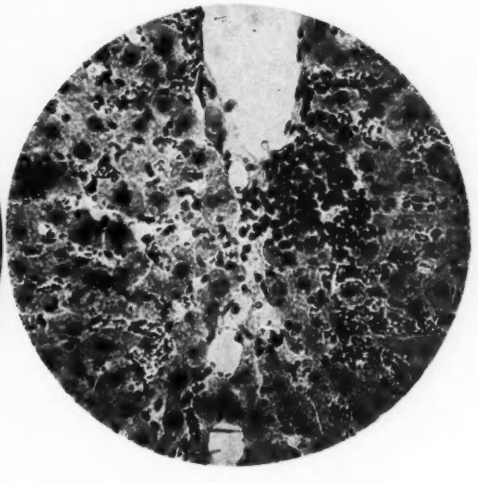


Fig. 7.

Fig. 6. Marked degenerative changes in the pancreas of animals treated with retene in sesame (450 × hematoxylin-eosin).

Fig. 7. Focal necrosis of the liver in animals receiving intracardiac injections of colloidal suspension of 1:2:5:6 dibenzanthracene in 6 per cent acacia (450 × hematoxylin-eosin).

The failure of very much of the dibenzanthracene solution to be absorbed in every experiment was not altogether unexpected because an injection given a rat two months before produced yellow-orange colored formations under the diaphragm, between the liver lobes, around the spleen,

TABLE XIV.—AUTOPSY FINDINGS

Treatment	Thymus	Lungs	Liver	Peritoneum	Spleen	Kidneys
Sesame oil (2 × 5 c.c.)	Normal	Normal	Swollen (all) Plaque of organized oil between dome and diaphragm	4 + organization of oil (all) Inflammation (2) Acetone odor (1) Extravasation of blood (1)	Normal	Normal
0.5 per cent 1:2:5:6 dibenzanthracene (2 × 5 c.c.)	Atrophy (all)	Normal	Swollen (2) Large plaques of organized material (all)	Sero-sanguinous oily fluid (all) Inflammation (1) Nodules of organized material (all)	All or part coated with 1:2·5:6 dibenzanthracene	Normal
1.0 per cent 1:2:5:6 dibenzanthracene (2 × 5 c.c.)	Atrophy (all)	Sero-sanguinous fluid in pleura (1)	Swollen (all) Large plaques of organized material (all)	Sero-sanguinous, oily fluid (all) Inflammation (all) Nodules (all)	All or part coated with 1:2:5:6 dibenzanthracene	Deposits (2)

with nodules throughout the omentum. Extraction with ether yielded a solution which gave the characteristic fluorescence under ultra-violet light.

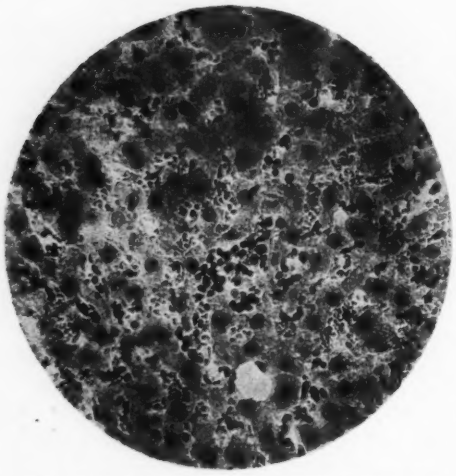


Fig. 8. Liver changes from intracardiac colloidal retene (450 × hematoxylin-eosin).

Intraperitoneal administration of 1:2:5:6 dibenzanthracene in sesame oil. Series of Aug. 4, 1937. (Table XIV, p. 691.)

Experiment 8.—The effect of different volumes and concentrations of acacia solutions on the growth of B, No. 2, from various volumes of inoculum. Series of May 24, 1937. Nine animals.

from suspensions of 0.01 c.c., 0.001 c.c., 0.0001 c.c., and 0.00001 c.c. Nine rats were inoculated with tumor B, No. 2, suspension in the same manner as in Experiment 5. The following day eight were injected intraperitoneally with the solutions of acacia as above described, and one was left as control. The result indicated in Table XV shows that acacia solutions so given had no stimulating effect on the size of the tumors resulting from the various volumes of inoculum.

DISCUSSION

Since the presence of illness tends to inhibit the growth of tumors, the observation that certain carcinogenic compounds do the same thing without making the animal sick would be of great significance. But when the experiment was repeated by the author, considerable injury was noted not only in rats which received the hydrocarbons but in the sesame oil controls as well. However, it is still important to note that, as a rule, acacia and household sesame oil did not tend to inhibit tumor growth, while the addition of the hydrocarbons retene and 1:2:5:6 dibenzanthracene to these compounds did.

Twort and Lyth (7) noted that when 0.5 c.c. of various mineral oils were injected intraperitoneally into 20-gram mice, a portion was recoverable in one week and that the introduction was followed by

TABLE XV

Concentration of Acacia	6 Per Cent		12 Per Cent		25 Per Cent		50 Per Cent	
Volume of Acacia Injected	2 c.c.	5 c.c.	2 c.c.	5 c.c.	2 c.c.	5 c.c.	2 c.c.	5 c.c.
Total Wt. Tumor Tissue per Rat	17.4 gm.	21.2 gm.	22.7 gm.	31.1 gm.	28.1 gm.	28.9 gm.	44.4 gm.	34.9 gm.

Untreated Control: Total wt. of tumor tissue 32.4 gm.

It had been noted casually that animals which had been treated with acacia solution seemed to be a little heavier in weight. Therefore, it was decided to try the effect of acacia solutions without hydrocarbons in amounts of 2 and 5 c.c., and in concentrations of 6 per cent, 12 per cent, 25 per cent, and 50 per cent on tumors grown

invasion of leukocytes, possible trapping of the oil and subsequent endothelial proliferation (peritonitis). They also found that painting mice with these oils caused fatty infiltration and hyaline degeneration of the liver.

Twort and Twort (8) found that painting mice with synthetic tar produced "a

certain amount of debilitating action" which was indicated in the higher correlation values for the various organs of the control groups except in the case of the brain and spleen.

Beltrami (9) noted that painting mice with 1, 2 benzpyrene, benzol, or anthracene caused changes in the liver and spleen of these animals suggestive of a general toxic reaction, since the splenic pulp and the blood vessel walls of the spleen and other organs were the site of amyloid degeneration, while the liver was the seat of foci of immature blood corpuscles in the portal spaces and capillaries of the lobules.

Pybus and Miller (10) report that intraperitoneal injections of solutions of 1:2:5:6 dibenzanthracene in mice caused a high mortality, with findings of peritoneal adhesions and degenerations of the liver and kidneys.

SUMMARY

A number of white rats of pure breed, bearing sarcomas (about 2.0 cm. or more in diameter), were given intraperitoneal injections of 1:2:5:6 dibenzanthracene or retene dissolved in sesame oil or in the form of a colloidal suspension in 6 per cent acacia. In one instance the colloidal suspension was administered in doses by the intracardiac route. Among other things, lard oil, sesame oil, and varying concentrations of acacia were also injected and their effects upon the animal and the tumor was noted. The following results were observed:

1. The hydrocarbon 1:2:5:6 dibenzanthracene definitely inhibited this tumor (B, No. 2) in every instance.
2. Retene also inhibited it, but to a lesser degree. Whether or not retene is carcinogenic is not known, but a series of rats are being injected to determine this feature.
3. Acacia did not inhibit.
4. All animals treated intraperitoneally showed considerable damage to the viscera: slight, with colloidal suspensions; marked, with sesame oil solutions. Lard oil was prone to excite marked cellular proliferation and organization in the peritoneal cavity.
5. The liver was always injured, even with minute doses of retene and dibenzanthracene given intracardiacally.
6. When distilled sesame oil caused definite peritoneal irritation, it inhibited tumor growth, but there was no instance of inhibition with the household brand.

It is, therefore, suggested that the inhibition of the sarcoma B, No. 2, may have been due, in part, at least, to constitutional damage and that the effect of 1:2:5:6 dibenzanthracene is not specifically directed against the neoplasms.

The author wishes to extend his thanks to Dr. Newton Evans, Pathologic Department, Los Angeles General Hospital, and to Dr. Roy Hammock for their assistance in diagnosing the microscopic sections; to Dr. William H. Woglom for reading the manuscript, and to his technical assistants, Patricia H. O'Hara, M.S., Anna Wiener, B.S., and Margaret A. Neely, R.N., for their untiring co-operation.

269 South Lake Street

REFERENCES

(1) HADDOW, A.: Influence of Certain Polycyclic Hydrocarbons on the Growth of the Jensen Rat Sarcoma. Nature, Nov. 30, 1935, **136**, 868, 869.

(2) HADDOW, A., and ROBINSON, A. M.: The Influence of Various Polycyclic Hydrocarbons on the Growth Rate of Transplantable Tumors. Proc. Royal Soc., London, 1937, **122**, 442.

(3) SCOTT, C. M.: Inhibitory Influence of 1:2:5:6 Dibenzanthracene on Body Growth in Rats. British Empire Cancer Campaign, 1936, p. 298.

(4) BURROWS, H., HIEGER, L., and KENNAWAY, E. L.: Experiments in Carcinogenesis: The Effect of the Subcutaneous and Intraperitoneal Injection of Lard, Olive Oil, and Other Fatty Materials in Rats and Mice. Jour. Path. and Bact., September, 1936, **43**, 419–426.

(5) BERENBLUM, I.: Notes on Colloidal Solution of 1:2:5:6 Dibenzanthracene. Lancet, 1932, **2**, 1107.

(6) HADDOW, A., SCOTT, C. M., and SCOTT, J. D.: The Influence of Certain Carcinogenic and Other Hydrocarbons on Body Growth in the Rat. Proc. Royal Soc., London, 1937, **122**, 477.

(7) TWORT, C. C., and LYTH, R.: Violence of Reaction of the Animal in Relation to the Etiology of Cancer and Inflammation. Jour. Hyg., August, 1935, **35**, 404–411.

(8) TWORT, J. M., and TWORT, C. C.: Further Observations on the Organs of Mice Painted with Carcinogenic Agents. Am. Jour. Cancer, January, 1937, **29**, 78–92.

(9) BELTRAMI, W.: Azione organismica generali di idrocarburi sintetici cancerogeni. Tumori, 1935, **9**, 537–547.

(10) PYBUS, F. C., and MILLER, E. M.: On the Effect of 1:2:5:6 Dibenzanthracene on Spontaneous Mouse Tumors. British Jour. Exper. Path., April, 1937, **18**, 126–137.

BLOOD VESSEL MARKINGS IN THE DORSAL VERTEBRAE SIMULATING FRACTURE[1]

PRELIMINARY REPORT

By KENNETH S. DAVIS, M.S., M.D., *Los Angeles*

From the X-ray Department, St. Vincent's Hospital, and the School of Medicine, University of Southern California

IN these days with court litigation more concerned in regard to unnecessary detail than with the broader principles of justice, it would seem wise to record an anomaly of the dorsal vertebræ which has been at least once interpreted as fracture and as such was the basis of litigation.

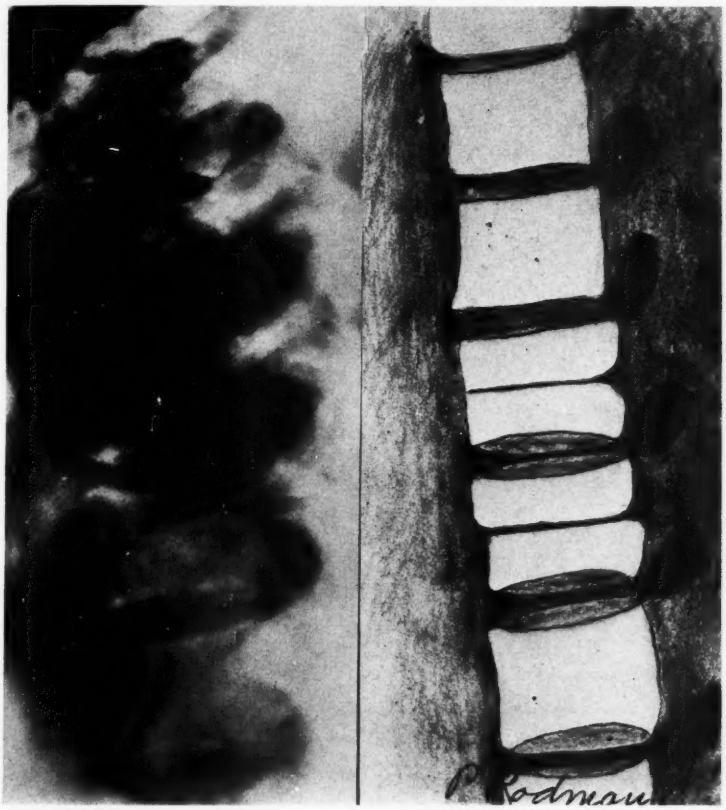


Fig. 1. Lateral roentgenogram of the dorsal spine in a man who had sustained injury in a railroad accident. The ninth and tenth vertebræ show transverse linear marks bisecting the vertebræ into two symmetrical halves. The upper half of the body of the tenth dorsal lies fully 3 mm. anterior to the lower half. This case brings up the interesting speculation of a divided vertebra, due either to failure of fusion of the primitive somites or to a persistence of the inter-segmental septum, with a possible displacement of the upper half of the body of the tenth dorsal as a result of the trauma. The twelfth dorsal, which was not included in this roentgenogram, showed a compression fracture.

Our attention was first drawn to this anomaly when we were called into court to interpret roentgenograms made of the

[1] Presented before the Fifth International Congress of Radiology in Chicago, Sept. 13–17, 1937.

Fig. 2. Lateral roentgenogram of the dorsal vertebræ in a colored male, 42 years of age, complaining of pain in neck and shoulders. No history of injury. On physical examination patient complains of tenderness on pressure over the spinous processes of the cervical and upper dorsal vertebræ. No tenderness could be elicited over the lower dorsal spine. This film illustrates the typical transverse linear marks in the dorsal vertebræ due to blood vessel channels in the vertebral body.

dorsal spine. These films showed definite transverse linear marks through the centers of the bodies of the ninth and tenth dorsal vertebræ, best seen in the lateral view but also demonstrable in the anteroposterior view. These lines apparently divided the body into two symmetrical halves, and in one of the roentgenograms the upper half of the body of the tenth dorsal apparently lay about 3 mm. anterior to the lower half (Fig. 1). There was also a fracture through the anterior superior margin of the twelfth dorsal with a moderate compression of the anterior margin of the body as a result.

A careful review of the lateral roentgenograms of the dorsal vertebræ in our files showed 43 cases in which this anomaly existed. Since then, in viewing lateral films in this region, this transverse linear mark has been observed in about 10 per cent of all cases (Fig. 2). It was seen in approximately the same percentage of non-traumatic cases as in those that had sustained trauma. These lines were found in persons from 20 to 76 years of age, the average age being about 42.

Being unable to obtain any postmortem material in our clinical cases, we secured the dorsal vertebræ from cadavers in the Department of Anatomy of the Medical School of the University of Southern California. Lateral roentgenograms of the removed spines showed an astonishingly high percentage of transverse linear marks in the dorsal vertebræ (approximately 22 per cent). The vertebræ showing these marks were then carefully dissected out and the blood vessels were injected with a mixture of barium and water. After injecting the blood vessels and taking anteroposterior, lateral, and longitudinal roentgenograms, the vertebræ were then sectioned, some transversely, some anteroposteriorly, and some longitudinally. These experiments revealed that the transverse linear marks were due to blood vessel channels in practically all instances (Figs. 3, 4, 5, and 6). The injected channels were always found to enter the vertebral body in approximately the center of the *posterior vertebral body wall*, extending anteriorly into the body for varying distances. In no instance were we able to trace the channel through the anterior surface of the vertebral body, although in some of the vertebræ the channel extended completely across the body (Fig. 4).

We were never able to demonstrate blood vessels or blood vessel channels entering the body directly on the anterior surface

except for an occasional small anomalous vessel.

Wagoner and Pendergrass (1), in their original research on the intrinsic circulation of the vertebral body, found that the main blood supply was received through branches from the anterior spinal artery which penetrates the body in the center of the *posterior* vertebral body wall just above the exit of the basi-vertebral veins. These

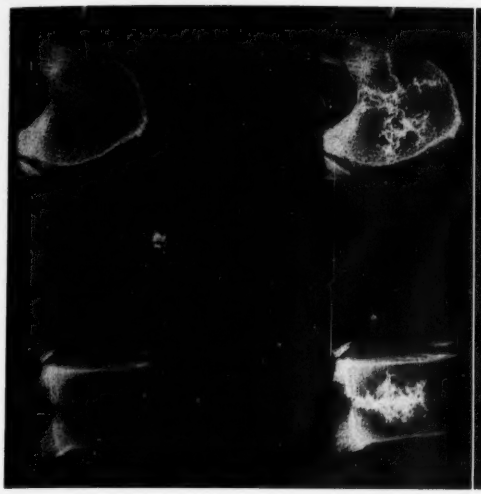


Fig. 3.

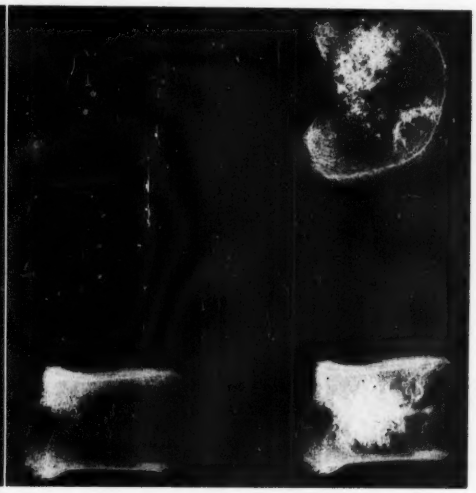


Fig. 4.

Fig. 3. Lateral and longitudinal roentgenograms of a dorsal vertebra before and after injection with barium and water. Note in the lateral view the notching of the *posterior* surface of the vertebral body at the point of emergence of the basi-vertebral veins.

Fig. 4. In the lateral roentgenogram of this vertebra the transverse linear mark extended to the anterior surface of the body. A careful search failed to show any continuance of the channel to the exterior of the body on this surface.

Fig. 5.

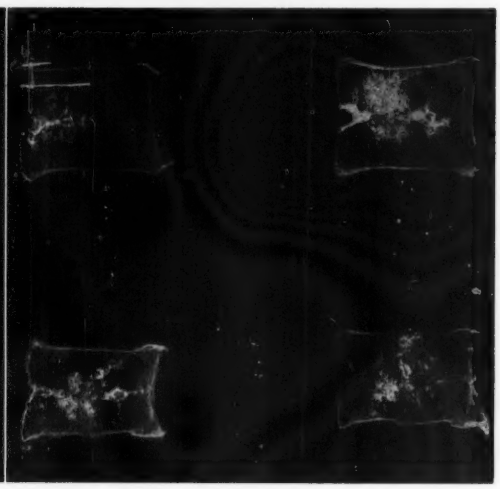


Fig. 6.

Fig. 5. This illustrates the venous sinusoidal system as described by Wagoner and Pendergrass. The sinusoids are visible in the lateral film before injection.

Fig. 6. Longitudinal sections through the vertebral bodies after injection. In one vertebra the blood vessel channel can be seen ending just beneath the anterior surface.

arteries could be followed into the central substance of the vertebral body before dividing. They found that the vertebral bodies drained by four main venous trunks. Two leave the body—one on either side—antero-laterally just above the mid-line. Two emerge from the center of the *posterior* vertebral body wall and are commonly called the basi-vertebral veins. Within the body these four veins meet to form a large central reservoir or sinusoidal venous system. Wagoner and Pendergrass found it impossible to demonstrate this sinusoidal system on the roentgenograms of a normal adult spine.

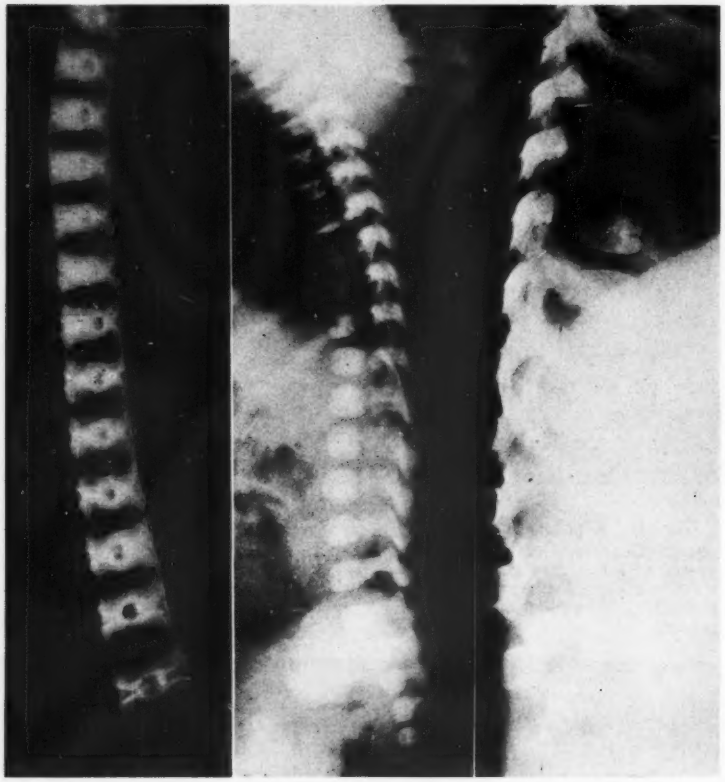


Fig. 7-*A*. Fig. 7-*B*. Fig. 7-*C*.

Fig. 7. Lateral spine of a fetus, infant, and child, respectively.

Fig. 7-*A*. Section through a fetal spine showing the three zones of osseous tissue as described by Hanson. The middle zone can be seen diminishing in its longitudinal measurements in the dorsal spine.

Fig. 7-*B*. A lateral roentgenogram of the spine in an infant, age six months. In the dorsal region the middle transverse zone of osseous tissue is prominent. This zone could be seen not only in the lateral but in the anteroposterior view as well.

Fig. 7-*C*. Lateral film in a three-year-old child showing the translucent "split" in the anterior part of the bodies of the dorsal vertebræ. Köhler states that this line is due to nutrient foramina, but in my opinion it is a residual mark of the middle transverse zone of osseous tissue, as described by Hanson.

Köhler (2), Hahn (8), and other German authorities (3, 5), have described a clear band-like translucent split extending from the middle of the *anterior* surface of the vertebral body into the body for varying distances. This finding was noted only in lateral roentgenograms of the spine in children and young adults. They attributed these lines to large nutrient foramina

and stated that the rarity of their appearance was due to the exceptionally rich blood supply of the vertebral bodies, which continues for only a short time in childhood and adolescence. Köhler states that these foramina are so large that one can pass an ordinary probe a good distance into the bone.

However, in our experimental work during which several hundred vertebral bodies were dissected we were never able to demonstrate any of these foramina. In fact, we were never able to find any blood vessels or blood vessel channels entering the body directly on the anterior surface except for an occasional small anomalous vessel.

Hanson (4), who first described the three zones of ossification in the spines of infants and young children, undoubtedly has given us a possible explanation for this "translucent split" on the anterior surface of the vertebral body during early life. The middle zone which is of lessened density in the roentgenogram consists of fully formed cancellous bone and contains fairly large blood vessel channels. This zone is routinely demonstrable in lateral roentgenograms of the spines of infants (Fig. 7). Above and below this central zone are two layers of ossifying cartilage which form bone much more dense than the "middle zone." A persistence of the shadow of the middle zone might well account for the "translucent split" seen in the anterior portion of the bodies of the vertebræ in children as first described by Köhler and Hahn (Fig. 8). No one has as yet observed the persistence of this notch or "split" in adult life. There is certainly no association of this *anterior "split"* with the translucent line seen in lateral roentgenograms of adult spines which are definitely blood vessel markings. These markings uniformly begin on the *posterior* margin of the body of the vertebræ, extending forward into the body for varying distances (Figs. 3, 4, 5, and 6).

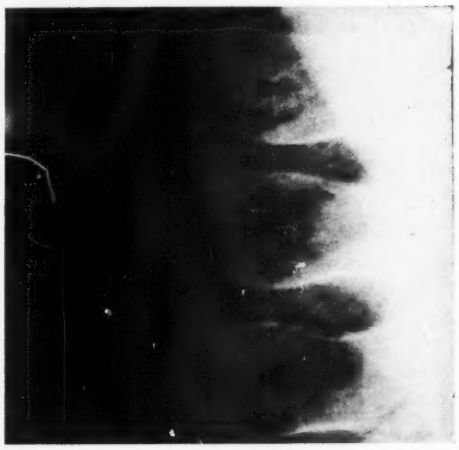


Fig. 8. Lateral roentgenogram of the dorsal vertebræ in a boy, seven years of age, showing the anterior translucent "split" as described by Köhler and Hahn. This line is absolutely different in both location and appearance from the transverse linear marks seen in lateral films of the dorsal spine in adults, the latter being due to blood vessel channels. Compare with Figures 3, 4, 5, and 6.

SUMMARY

1. In the great majority of cases transverse translucent linear marks in the dorsal vertebræ seen in profile views of adults are due to blood vessel channels.

2. The blood vessels enter the vertebral body posteriorly and antero-laterally in the mid-line, *but they do not enter from the anterior surface.*

3. The notching or "split" in the anterior margins of the dorsal vertebral bodies in children is in all probability developmental, as has been described by Hanson.

4. The translucent line seen in lateral roentgenograms of adult spines is not associated with the notching and translucent "split" seen in the anterior margin of the vertebræ of infants and young children.

BIBLIOGRAPHY

(1) WAGONER, GEORGE, and PENDERGRASS, EUGENE: Intrinsic Circulation of the Vertebral Body, with Roentgenologic Considerations. Am. Jour. Roentgenol. and Rad. Ther., June, 1932, **27**, 818–826.

(2) KÖHLER, ALBAN: Roentgenology, fifth ed., Baillière, Tindall, and Cox, London, 1931, p. 211.

(3) ENGEL and SCHALL: Handbuch der Röntgendiagnostik und therapie im Kindesalter. Georg Thieme, 1933, pp. 111, 112.

(4) HANSON, ROBERT: On the Development of

the Spinal Vertebræ as Seen on Skiagrams, from Late Fetal Life to the Age of 14. Acta Radiol., 1926, **5**, 112–126.

(5) SCHMORL, GEORG, and JUNGHANNS, HERBERT: Die Gesunde und Kranke Wirbelsaule im Röntgenbild. Georg Thieme, 1932, pp. 3, 5, 6, and 15.

(6) KEITH, SIR ARTHUR: Human Embryology and Morphology. Fourth edition, Edward Arnold, pages 59–65.

(7) SPALTEHOLZ, WERNER: Hand Atlas of Human Anatomy, second ed., J. B. Lippincott, **11**, pp. 419 and 454.

(8) HAHN, O.: Scheinbare Spaltbildung der Wirbelkorper in der Adolesenz. Fortschritte, 1922, **29**.

THE NECK[1]

A ROENTGENOLOGIC STUDY

By SAMUEL BROWN, M.D., J. E. McCARTHY, M.D., *and* H. G. REINEKE, M.D.,
Cincinnati, Ohio

From the Jewish, Good Samaritan, and General Hospitals

IT is a generally accepted truth that a knowledge of anatomy and physiology of a structure constitutes the basis for a diagnosis. It is for this reason that much space will be allotted to a discussion of the roentgen anatomy and physiology of the soft structures of the neck.

A review of the literature of the roentgenologic study of the neck reveals three periods of activity. The first, beginning with the discovery of the x-ray to the year 1914, was characterized by considerable interest in the roentgen study of the soft structures. From 1914 to 1927, the literature was barren in reference to this subject. From 1927 on, numerous valuable scientific contributions have been made.

During the first period a great deal of importance was attached to the diagnosis of foreign bodies lodged in the food and air passages. This is exemplified by the following statement by Carl Beck (1), in 1904, in one of the earliest text-books on the roentgen ray: "If the roentgen rays had done nothing else but locate foreign bodies in the throat, they would represent one of the greatest blessings to suffering humanity." In the same text-book the author discusses the diagnosis of aneurysms of the carotid and subclavian arteries, tumors of the larynx, goiter, and concretions in the submaxillary glands. Sinclair Tousey (2), another American author of an early roentgen-ray text-book, in 1910 discussed the roentgen anatomy of the larynx and various diseases of the neck diagnosed by the x-rays. Among the important contributions to the advancement of our knowledge of the roentgenology of the neck of this period are those of Frankel (3), Scheier (4), Thost (5), and Iglauer (6). A great deal of credit is due these men for developing x-ray technic, the description of the roentgen anatomy and physiology of the soft parts, and the diagnosis of abnormal changes affecting the latter. All this was accomplished in spite of the limitations of the apparatus of that time. In the second period nothing was added to our knowledge. There was but one contribution and that by Pfahler (7), who described a new roentgenographic technic for the study of the thyroid gland.

The third period is rich in many original scientific contributions. Mosher (8) discussed the movement of the tongue, epiglottis, and hyoid bone during swallowing. One year later (1928) Brown and Reineke (9) published a paper dealing with the roentgen anatomy of the soft structures of the neck and the diagnosis of various affections. This paper was characterized by Pancoast as "a preface to the roentgenologic study of the neck." This was later (1930) supplemented by another paper (10) which dealt with the superior and posterior mediastina and some affections of the neck. In the same year (1928) Hickey (11) contributed an invaluable paper on the normal anatomy of the larynx in which he emphasized the importance of placing the film close to the neck in order to obtain better detail. In 1930 Hay's (12) excellent monograph appeared, which, by the way, has been a constant companion in our studies. In the same year Barclay (13) contributed a paper on the normal mechanism of swallowing and later discussed the same subject in his monograph (14) on the digestive tract (1933). In 1930 Pancoast (15) published a highly scientific paper dealing with the roentgenology of the upper re-

[1] Read before the Fifth International Congress of Radiology, Chicago, Sept. 12–17, 1937.

spiratory tract, with special reference to the larynx and adjacent structures. Together with Pendergrass (16) he presented a paper concerning the roentgenologic diagnosis of diseases of the upper respiratory tract in children. In 1933 Pancoast (17) presented an excellent contribution dealing with the roentgenology of the pharynx and cervical esophagus. Jackson (18 and 19) contributed (1930 and 1936) valuable papers on the soft structures of the neck. Pack and Craver (20) discussed at length the diagnosis and treatment of tumors of the larynx and thyroid (1931). An evaluation of roentgenology in otolaryngology was presented by Golden (21) in 1933. The following year Jönsson (22) described a new method for roentgen examination of the hypopharynx and upper air passages, which consisted in making use of the Valsalva experiment. This has proven to be valuable in our work. In the same year Hirsch and Baum (23) contributed an elaborate study on the roentgen diagnosis and treatment of laryngeal tumors. The following year (1935) Chamberlain and Young (24) published a paper on the ossification of the normal laryngeal cartilages. Recently (1936) there has appeared a valuable paper by Taylor (25) in which he discusses ossification of the laryngeal cartilages under normal and abnormal conditions.

Among the many who contributed papers on the diagnosis of foreign bodies in the throat, those of Iglauer and Ransohoff (26) in 1924, Tucker (27) in 1925, and Manges (28 and 29) from 1927 to 1929 are outstanding, for the principles of diagnosis that they developed can be applied in many diverse situations.

In this paper it is planned to incorporate the knowledge gained from the study of the above contributions with our own observation of many years of the roentgen anatomy and physiology of the neck under normal and abnormal conditions.

X-RAY TECHNIC

Great improvements have taken place in the character of the roentgenograms of the neck resulting from several factors, namely, increased milliamperage and kilovoltage, greater distances and shorter exposures, so that it is now possible to obtain sharply defined roentgenograms. During the past few years, with few exceptions, we have used the same technic for the neck as for the thorax: 70-80 kv., 60 ma.; 6 feet distance; time, about one-half to one second, in the sitting position. This technic is modified in the case of infants and children whose co-operation is generally hard to obtain. Under these conditions, we use the horizontal position which is more adapted for the proper immobilization of the neck and a shorter distance. In general, relatively good diagnostic roentgenograms are obtained. For patients who are too ill to sit up the recumbent position is also necessarily used.

For the lateral view of the neck we make use of Grandy's (30) technic for the cervical spine, which consists in having either shoulder resting against the vertical cassette changer. The head and neck are held parallel to the cassette and are steadied by an assistant. The patient is instructed to hold the breath and not to swallow during the exposure. When the movements of the pharynx, larynx, trachea, tongue, hyoid bone, and soft palate are desired to be demonstrated, the patient is instructed to go through the motions of the act of swallowing, phonation, or respiration, and remain in that state during the x-ray exposure. For the anteroposterior view the same factors are used with the exception that the dorsal surface of the neck rests against the cassette. At times we find it preferable to use the horizontal position for the anteroposterior view, together with the Potter-Bucky diaphragm.

The roentgenograms of the neck obtained with the above technic have been highly satisfactory. The soft structures are sharply outlined, and any abnormal change is readily recognized. So far, no attempt has been made to differentiate those structures which lie laterally and posteriorly to the cervical spine—muscles,

blood vessels, nerves, glands, and fascia. The recently introduced pneumofasciagram of Gratz (31) may prove of service, but, so far, we have not made use of this method. We do have several cases of spontaneous pneumofasciagrams as a result of accidents which have proven instructive in differentiating some of the soft structures.

THE ROENTGEN ANATOMY AND PHYSIOLOGY OF THE NECK

In general, the neck has the shape of an oblique cylinder linking together the head above and the thorax below. The upper and lower boundaries of the neck are on a lower level anteriorly than posteriorly, so that there is a considerable superimposition of the structures in the anteroposterior view, the upper region of the neck being overlapped by the facial structures, the lower by the thoracic. The length and thickness of the neck depend upon the age of the individual and his habitus. Individuals of the asthenic type have long and narrow necks; of the sthenic type, short and broad. In infants the neck is usually short, and, relatively speaking, broad. The internal structures of the neck generally conform in length and breadth to that of the external.

The structures of the neck which can be identified by the x-ray are as follows: (1) cervical spine; (2) muscles, subcutaneous tissue, and skin; (3) prevertebral fascia; (4) posterior pharyngeal wall; (5) naso-, oro-, and laryngo-pharynx; (6) soft palate and uvula; (7) passage between mouth and pharynx; (8) base of tongue and lingual tonsil; (9) mandible and hyoid bone; (10) epiglottic vallecula and epiglottis; (11) aryepiglottic folds and arytenoid cartilages; (12) laryngeal vestibule; (13) ventricular folds; (14) vocal cords; (15) thyroid cartilage; (16) cricoid cartilage; (17) trachea; (18) pyriform sinuses; (19) esophagus; (20) tonsils; (21) glands, chiefly the thyroid.

In the anteroposterior position (Fig.1) the cervical spine occupies about the middle third of the roentgenogram. On each side of the spine there is a column of undifferentiated soft tissue consisting of muscles, blood vessels, nerves, and glands. In a pneumofasciagram of the neck (Figs. 2 and 3) some of the muscle layers can be differentiated by the intervening air in the fascial planes. Superimposed upon the spine are a number of important structures which, however, cannot be recognized. The trachea, because it is air-containing, is readily differentiated. It is located in the median plane in front of the spine, commencing at the level of the body of the fifth cervical vertebra when at rest, and extending downward into the thoracic cavity. Above, the walls of the trachea gradually converge resembling a cone, the apex of which corresponds to the region of the true vocal cords. On each side of the tracheal cone the alæ of the thyroid cartilage are often recognized when they are ossified. They lie at the periphery of the cervical vertebræ, gradually diverging in their upward course. The end of the tracheal cone is located in the center of the so-called thyroid cartilage box. The pharynx and esophagus cannot be recognized on a plain anteroposterior view unless barium or other opaque medium is swallowed (Fig. 4). The lumen of the pharynx appears to be rather broad from side to side, but below the fifth cervical vertebra it abruptly narrows in its downward passage. This narrowing corresponds to the lumen of the cervical portion of the esophagus.

In the lateral position of the neck (Fig. 5) the cervical spine again occupies approximately the middle third. Behind the spine there is a layer of soft tissue which can be differentiated into three zones on account of slight variation in their density, corresponding to the skin, subcutaneous fatty tissue, and muscles.

In front of the spine there are several important structures: the pharynx, larynx, trachea, esophagus, hyoid bone, base of the tongue, soft palate, and tonsils. These are readily differentiated because some of them are air-containing, while the others are dense enough to make them stand out in contrast to the former.

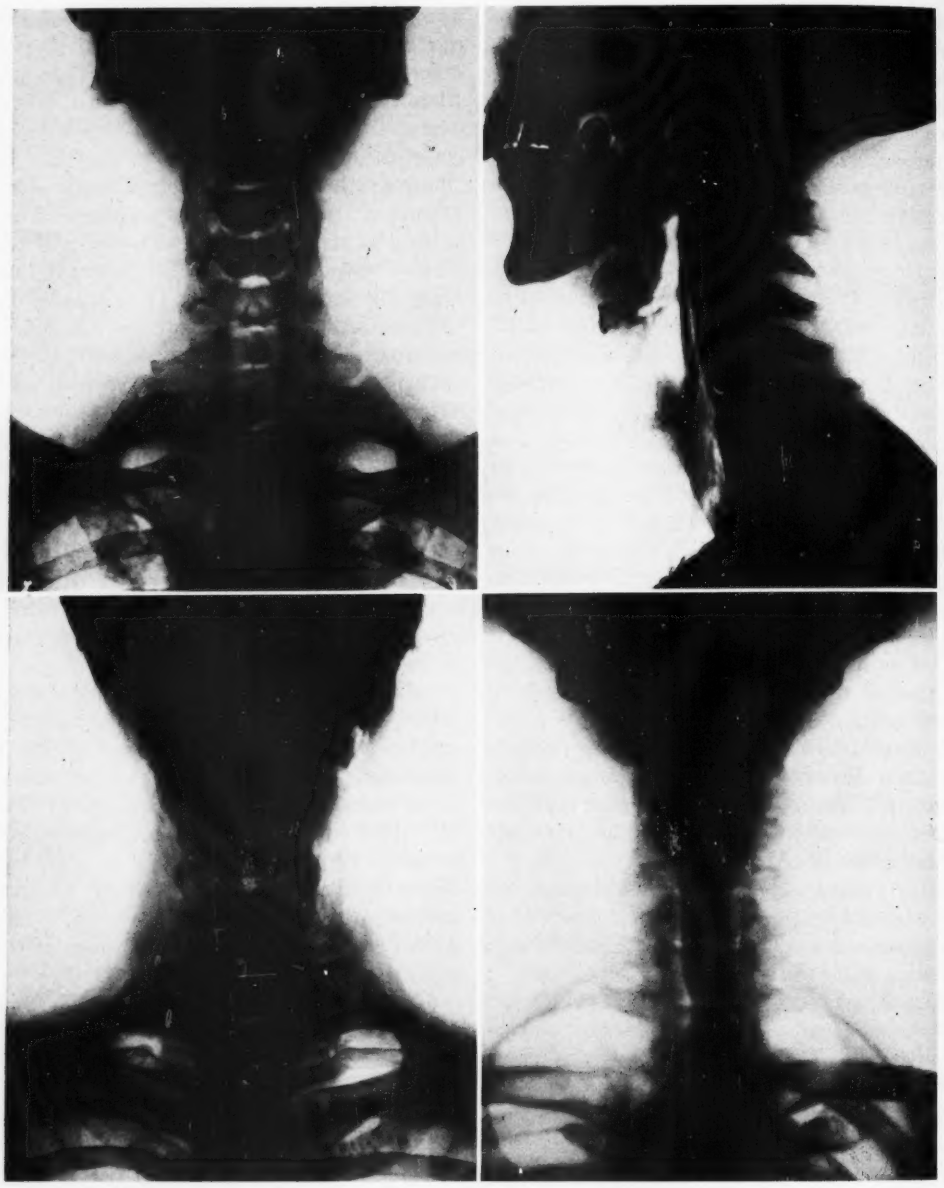


Fig. 1 (*upper left*). Dorsal view. The trachea is distinctly outlined. The upper end is shaped like a cone, the apex of which corresponds to the true vocal cords. At the periphery of the spine there is noted the ossified alæ of the thyroid cartilage.

Fig. 2 (*upper right*). Lateral view. Spontaneous pneumofasciagram as a result of traumatism. Note the free air between the posterior wall of the pharynx and prevertebral fascia.

Fig. 3 (*lower left*). Anterior view. The same case. Note the free air along the fascial planes.

Fig. 4 (*lower right*). Anterior view. Barium-filled pharynx and esophagus. The pharynx is broad, the esophagus is narrow.

The pharynx extends from the base of the cranium to the level of the body of the sixth cervical vertebra, where it is continuous with the esophagus. It is widest

above at the base of the cranium and gradually narrows to the level of the larynx, known as the pyriform sinuses, and then rapidly narrows to its termination. Posteriorly, the wall of the pharynx is complete and lies anterior to the upper six cervical vertebræ, being separated from the latter by the prevertebral fascia and muscles. The thickness of these structures varies, being wider above than below, and wider in infants and young children than in adults. Anteriorly the pharynx communicates with the nasal cavities, mouth, and larynx. Between the naso- and oro-pharynx project the soft palate and uvula, which under ordinary conditions rest upon the dorsum of the tongue. During phonation or deglutition they become elevated, assuming the shape of a hammer-toe, thus separating the naso-pharynx above from the oro-pharynx below and preventing food from entering the upper cavity. The oro-pharynx lies posteriorly to the mouth and tongue, the latter of which forms its anterior wall. The laryngeal portion of the pharynx communicates with the larynx, and its anterior boundary is formed by the epiglottis and the posterior surfaces of the arytenoid and cricoid cartilages. The naso-pharynx remains patent at all times and changes its size but little. The transparency of this cavity is, however, less marked than in the other sections on account of the overlapping of the rami of the mandible and parotid glands. Occasionally one may see the styloid processes and the stylo-hyoid ligaments which, when calcified, cross the cavity diagonally (Fig. 6). The oro- and laryngo-pharynx have considerable latitude in their capacity to expand, thus altering more or less in their shape and size. Under ordinary respiration there is little change, but during forced expiration or inspiration the cavity diminishes or increases, respectively. During swallowing the pharyngeal cavity is almost entirely obliterated (Fig. 7). This is brought about by the contraction of the pharyngeal muscles, the backward displacement of the tongue, and elevation of the larynx During the phonation of certain vowels, such as "*Â*" (Fig. 8), the cavity somewhat diminishes, while in the pronunciation of "*E*" (Fig. 9) the cavity increases. During the Valsalva experiment, which consists of forced expiration after a deep inspiration with the nose and mouth closed, the cavity enlarges considerably. In addition, air may be noted in the esophagus extending to the level of the crico-pharyngeus muscle (Fig. 10).

The cervical portion of the esophagus begins at the level of the cricoid cartilage and extends downward in front of the cervical vertebræ. The lumen of the esophagus is only a potential one and is visualized during the passage of an opaque material. Otherwise its position is recognized by a column of non-differentiated soft tissue about one centimeter in width between the spine and trachea. Ordinarily its thickness does not exceed two-thirds of the anteroposterior diameter of the body of the sixth cervical vertebra.

The visualization of the pharynx and upper end of the esophagus by an opaque medium on a roentgenogram is rather difficult because of the rapid passage of the food. We have succeeded in some cases of pharyngitis in which the passage of food was delayed (Figs. 11 and 12). Fluoroscopically the process of deglutition is readily observed. When the bolus of food is swallowed the soft palate is elevated up to a horizontal position and, so-to-speak, closes the naso-pharyngeal opening. The food is seen to travel along the curvature of the dorsum of the tongue until it reaches the vallecula, the depression between the dorsum of the tongue and the epiglottis. At once the larynx and hyoid bone ascend and the epiglottis turns backward and downward so that the bolus is directed to the posterior and lower portion of the pharynx into the pyriform sinuses and thence into the esophagus.

THE TONSILS

Between the angle of the mandible and the cervical spine there is occasionally

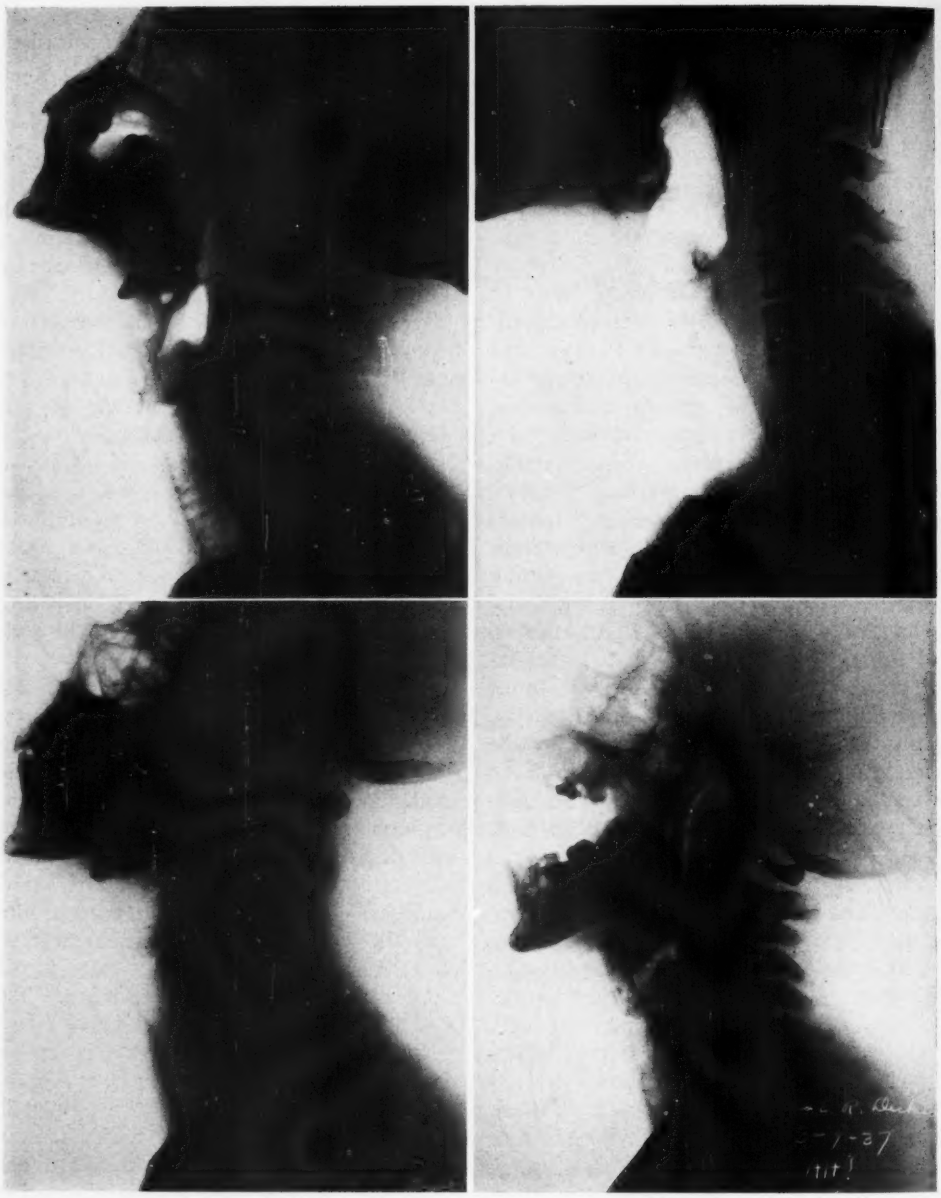


Fig. 5 (*upper left*). Lateral view. The pharynx is outlined in its entire course. The laryngeal cartilages are uniformly ossified (male).

Fig. 6 (*upper right*). Lateral view. The stylohyoid ligament is ossified and is shown between the hyoid bone and styloid process.

Fig. 7 (*lower left*). Lateral view. The pharyngeal cavity is obliterated during the act of swallowing. Note the elevation of the hyoid bone and larynx.

Fig. 8 (*lower right*). Lateral view. The pharyngeal cavity is greatly diminished in size during phonation of the vowel "*A*." Note the backward displacement of the tongue.

noted an oval-shaped shadow in the pharynx which is due to the tonsils (Fig. 13).

THE LARYNX

The larynx (Fig. 14) occupies the upper

Fig. 9 (*upper left*). Lateral view. The pharyngeal cavity is greatly increased during the phonation of the vowel "*E*." Note the forward displacement of the tongue and epiglottis, also the opening of the ventricle.

Fig. 10 (*upper right*). Lateral view. Valsalva experiment. The pharynx is dilated. Note the air in the upper end of the esophagus.

Fig. 11 (*lower left*). Lateral view. The pharynx is filled with barium. Note the barium in the vallecula and pyriform sinuses.

Fig. 12 (*lower right*). Anterior view. Note the barium-filled vallecula which is separated by the glosso-epiglottic fold into two pouches. The pyriform sinuses are filled with barium.

and anterior part of the neck, below the hyoid bone and tongue and continuous with the trachea below. Its position is not fixed, being freely movable during the act

of swallowing. The larynx is divided into three portions, upper, middle, and lower. The upper, known as the vestibule, extends from the superior opening of the larynx to the ventricular folds, its width diminishing from above downward. Anteriorly it is bounded by the posterior surface of the epiglottic and thyro-epiglottic ligaments. Each lateral wall of the vestibule is formed by the aryepiglottic fold. The posterior wall of the vestibule is narrow and corresponds to the interval between the upper part of the arytenoid cartilages. The epiglottis projects upward to the root of the tongue. Its movements during phonation and deglutition determine the size of the vallecula. The middle subdivision of the laryngeal cavity is very small and is bounded above by the ventricular folds and below by the vocal cords. These folds are frequently visualized, more often in the female than in the male and before complete ossification of the cartilages has occurred. Anteriorly and posteriorly the folds join, forming commissures, and extend from the thyroid cartilages in front to the arytenoid cartilages behind, being attached laterally to the laryngeal walls. The size of the ventricle between the folds varies, depending upon phonation—the enunciation of "*E*" widens it considerably. The rima glottidis cannot be recognized on the roentgenograms. The lower subdivision of the laryngeal cavity extends from below the true vocal cords to the trachea.

The thyroid cartilage is the largest one of the larynx. It consists of two broad plates, termed alæ, which meet anteriorly at an angle and become fused along the median plane. Posteriorly the alæ diverge from each other, and terminate above and below by slender projections known as the cornua. The superior cornu is attached to the cornu of the hyoid bone by a ligament. Midway between the cornu of the thyroid cartilage and the cornu of the hyoid is the cartilage triticea which, when ossified, can readily be visualized. Its existence should be kept in mind as it may be confused with foreign bodies.

The cricoid has the shape of a signet ring, being narrow anteriorly and broad posteriorly. The superior border articulates posteriorly with the arytenoid cartilages. The lateral surfaces of the cricoid articulate with the inferior cornua of the thyroid cartilage. At times a small hook-like projection is noted behind the posterior surface of the cricoid, which may be occasionally mistaken for a foreign body. At times it is possible to identify the corniculate and cuneiform cartilages when ossified.

The trachea is a wide patent tube held in this shape by cartilaginous rings embedded in its walls. Being deficient in cartilage posteriorly the anterior portion is visualized only when the rings ossify. In the neck the trachea is in the median plane, anterior to the esophagus and in contact with the lobes of the thyroid gland laterally. The trachea is not rigid, its length and breadth vary, depending upon the force of inspiration. This can be demonstrated by the Valsalva experiment.

Ossification of the laryngeal cartilages usually begins at the end of the second decade. The cricoid is the first to show signs of ossification, and is followed by gradual ossification of the thyroid. The degree of opacity of the larynx depends upon the ossification of its constituent parts. In general, no definite rule can be drawn as regards the exact time, form, and degree of ossification on account of a marked variation in different individuals, within normal limits.

The thyroid gland can often be recognized by a slight bulge of the soft tissue in front of the trachea, but its exact outline cannot be made out.

The hyoid bone is located under the mandible. It consists of a body and two cornua which in adults unite to form one bone. The cornua cross the pharynx anteroposteriorly and are parallel to the mandible. The hyoid bone is freely movable, especially during the process of deglutition.

DISEASES OF THE NECK

The Cervical Spine.—We are not primarily interested in the spine, except insofar as it may affect the soft structures of the neck. It should be studied both in the anteroposterior and lateral positions. Fractures, dislocations, and hypertrophic changes will often alter the normal contour of the pharynx and esophagus. Newgrowths of the spine, either primary or secondary, were also noted to affect the relationship of the adjacent structures. In a case of neurofibroma there was considerable distortion of both the hard and soft structures of the neck. Tuberculous lesions of the spine may produce considerable distortion of the posterior wall of the pharynx because of the secondary formation of a chronic retropharyngeal abscess (Fig. 15).

The Pharynx.—The most important lesions of the pharynx are tumors, benign and malignant, and acute retropharyngeal abscesses. Tumors in the retropharyngeal region are recognized by more or less obliteration of the cavity by a shadow of soft consistence. Of course, the exact nature of the tumor cannot be determined.

Retropharyngeal abscess of the acute type is readily recognized by the widened space between the spine and posterior pharyngeal wall (Fig. 16). Such an abscess may involve the entire space and at times extend into the posterior mediastinum. The pharynx, larynx, and trachea are displaced forward—the degree depends upon the size of the abscess. The presence of an air bubble in the retropharyngeal space is pathognomonic of an abscess and is invariably due to a perforation by a foreign body. Swelling of the retropharyngeal space is not always due to tumors or abscesses and may be the result of a cellulitis. One of the largest swellings we have encountered was due to the latter.

Tumors arising from the anterior boundary of the pharynx are usually of nasal or oral origin. Carcinoma of the base of the tongue produces a deformity of its pharyngeal wall and often extends to the vallecula. This can be demonstrated more satisfactorily by an opaque medium. The epiglottis is often found to be thickened and not freely movable.

Acute or chronic pharyngitis shows, in general, swelling of the mucous membrane (Fig. 17). Dysphagia is quite marked and the passage of food is impeded, thus enabling one to visualize the pharynx by means of an opaque medium.

Esophagus (Cervical Portion).—Pharyngeal diverticula are the most frequent affections met with in the region of the cervical portion of the esophagus. They usually arise at the junction between the pharynx and esophagus. In the lateral position of the neck it is often possible to recognize the lesion even without the ingestion of an opaque medium if a fluid level accompanies the widening between the spine and the trachea (Fig. 18).

Pharyngoceles occur infrequently. They are best demonstrated in the anteroposterior position during a Valsalva experiment (Fig. 19).

Newgrowths of the cervical portion of the esophagus rarely occur. When present, they are demonstrated by the deformity produced in the lumen as shown by the opaque medium. Occasionally there is almost complete obstruction and no barium can enter. In these cases one will often notice a widening of the space between the spine and trachea due to the tumor.

The Larynx.—Acute or chronic laryngitis can be recognized by the increased thickness of the epiglottis, arytenoid cartilages, and aryteno-epiglottic folds (Fig. 20).

In advanced carcinoma of the larynx the outline of the various structures comprising the larynx is poorly defined. Areas of increased transparency due to absorption of the ossified cartilaginous tissue may be recognized. The vocal cords are seldom demonstrated (Fig. 21).

Papillomas of the larynx can often be visualized on account of the sharpness of their outline on the transparent background. A case of a benign papilloma on the vocal cord was demonstrated only after the opening of the ventricle follow-

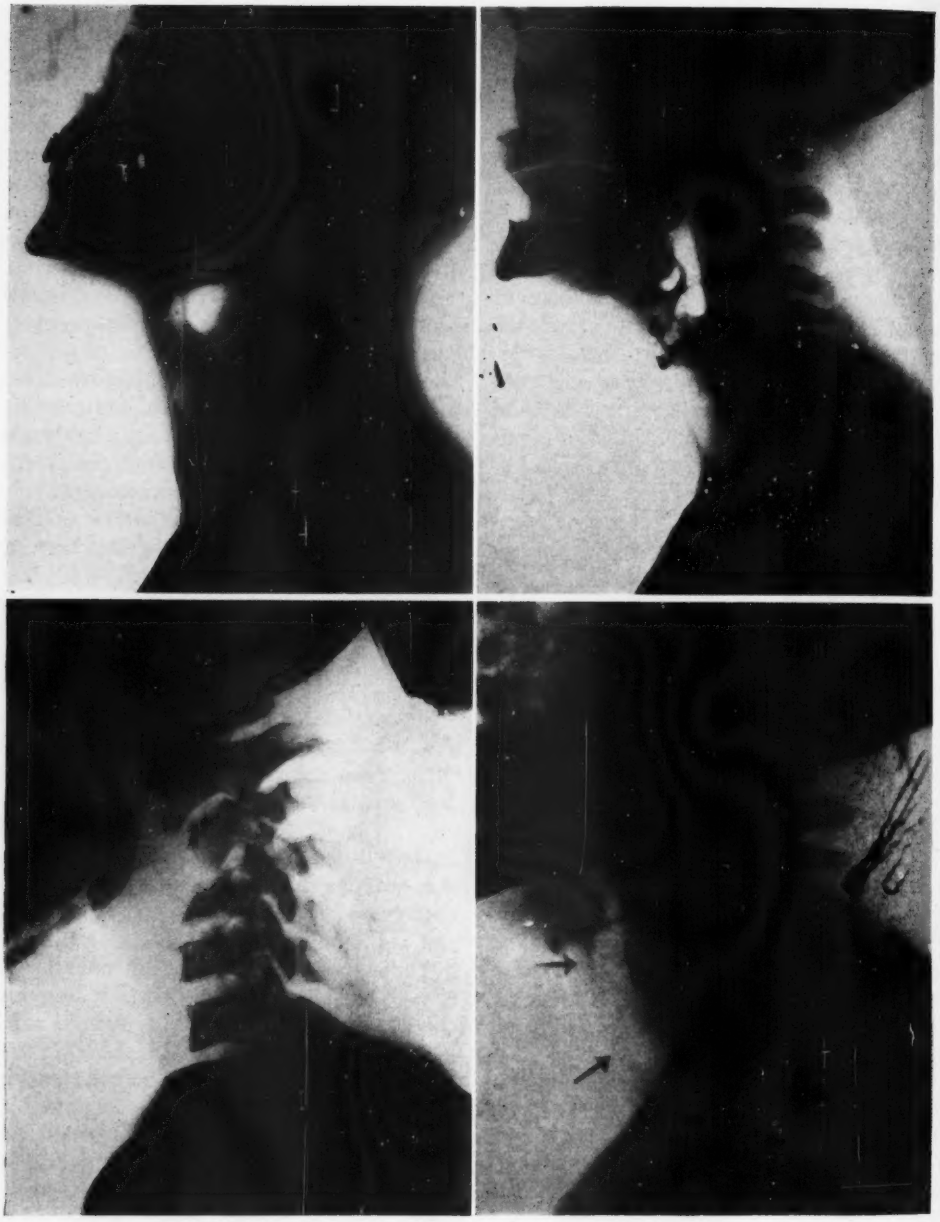


Fig. 13 (*upper left*). Lateral view. The oval-shaped shadow behind the angle of the jaw is apparently due to an enlarged tonsil. In re-examination after surgical removal the shadow was no longer seen.

Fig. 14 (*upper right*). Lateral view. The laryngeal cartilages are not uniformly ossified. This is frequently the case in females.

Fig. 15 (*lower left*). Lateral view. Tuberculosis of the spine with a large retropharyngeal abscess.

Fig. 16 (*lower right*). Lateral view. Large retropharyngeal abscess. Note the air bubble which is pathognomonic of a perforation. Also note foreign body adjacent to the air bubble.

ing the enunciation of the vowel "*E*" (Figs. 22-*A* and 22-*B*).

Extrinsic tumors are not difficult to diagnose roentgenologically. In the lat-

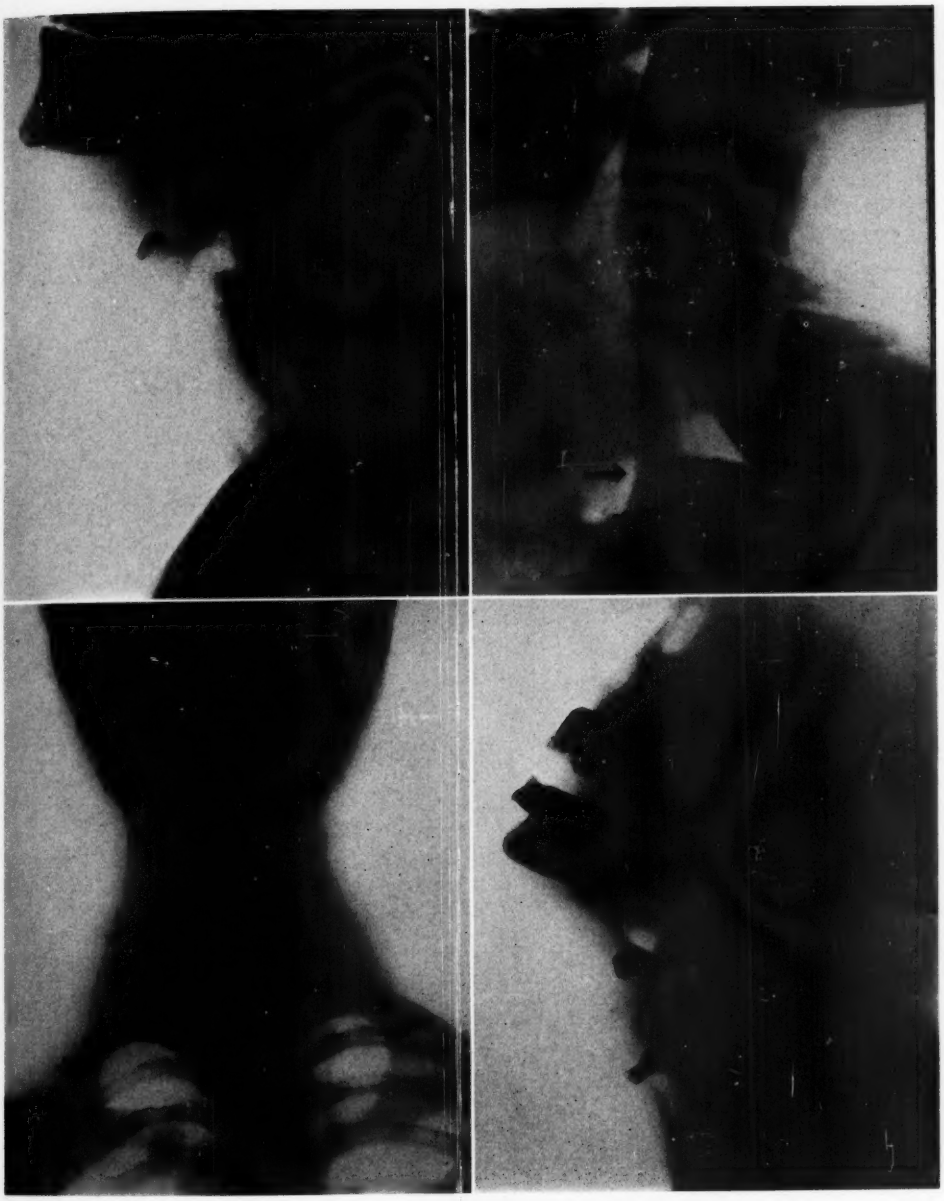


Fig. 17 (*upper left*). Lateral view. Acute pharyngitis. Note the thickening of the posterior wall of the pharynx and epiglottis.

Fig. 18 (*upper right*). Lateral view. Pharyngeal diverticulum. Note the widening between the trachea and spine, also fluid level with air above it.

Fig. 19 (*lower left*). Anterior view. Pharyngoceles. Note the air bubbles at the periphery of the spine below the mandible. Their demonstration is accomplished by the Valsalva experiment.

Fig. 20 (*lower right*). Lateral view. Chronic laryngitis. Note the thickening of the epiglottis.

eral position, the larynx and trachea are displaced forward. After the ingestion of barium the dislocation of the esophagus can be demonstrated.

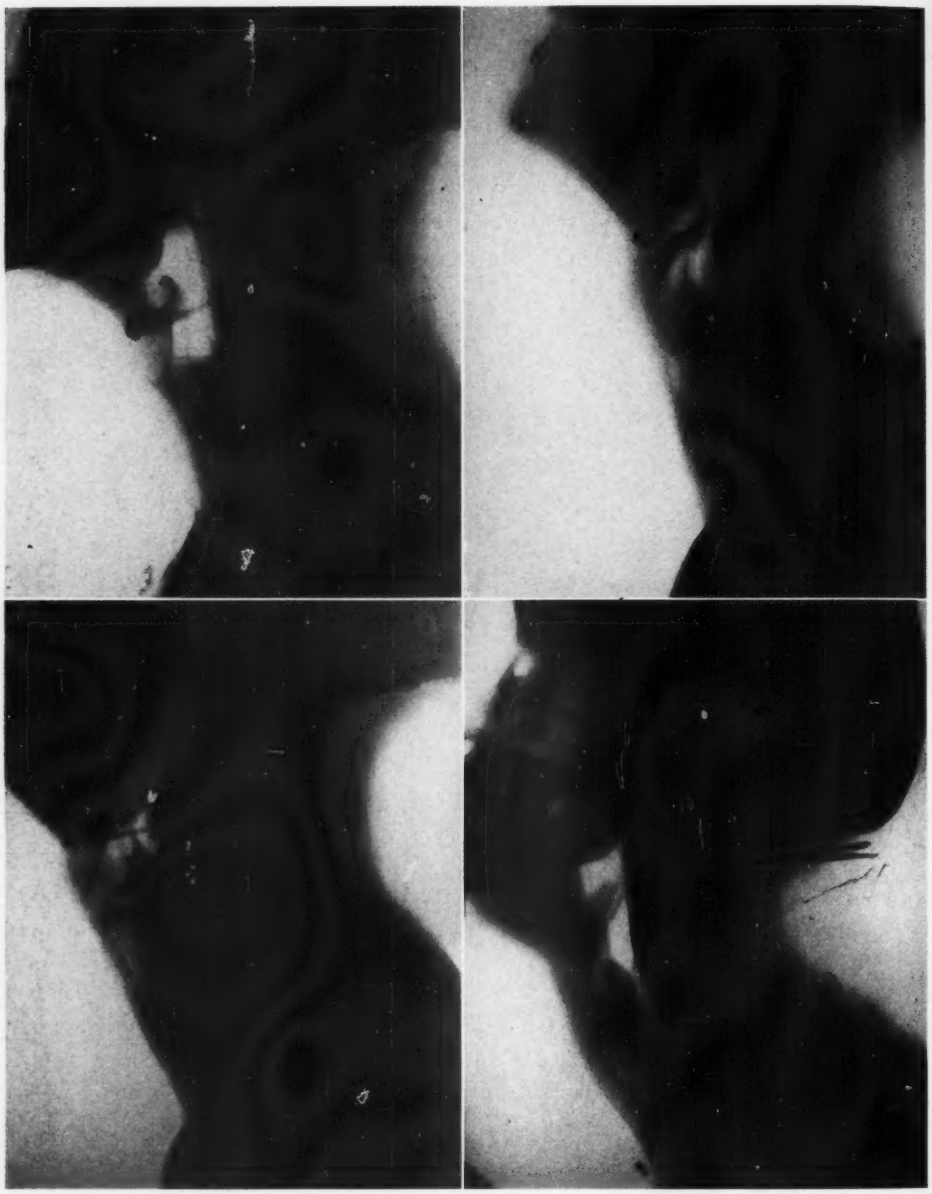


Fig. 21 (*upper left*). Lateral view. Carcinoma of the larynx. Note the poorly outlined larynx. The ossified cartilages show marked absorption.

Fig. 22-*A* (*upper right*). Lateral view. Papilloma of the larynx. The outline of the larynx is normal. The ventricle is closed. No abnormalities are demonstrable.

Fig. 22-*B* (*lower left*). Lateral view. The same case after the enunciation of the vowel "*E*." Note the opening of the ventricle which shows a nodule on the true vocal cord.

Fig. 23 (*lower right*). Lateral view. Laryngeal tuberculosis. Note the fragmentation of the ossified laryngeal cartilages. Valsalva experiment was used in the examination.

Tuberculosis of the Larnyx.—The cases of laryngeal tuberculosis that have come under our observation have been, as a rule, late. We, therefore, cannot discuss

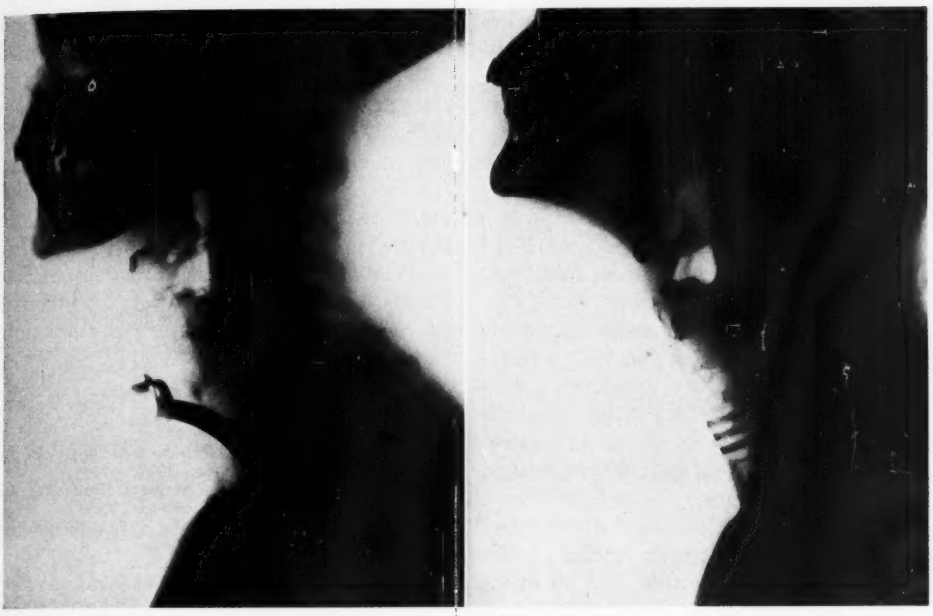


Fig. 24 (*left*). Lateral view. Laryngeal stenosis due to diphtheria. Note the excessive ossification of the laryngeal cartilages. Male, 25 years of age.

Fig. 25 (*right*). Lateral view. Note the marked excessive ossification of the laryngeal cartilages and tracheal rings, believed to be due to x-ray treatment for a goiter. A high degree of telangiectasis was also present.

the early roentgenologic changes. In one, the epiglottis and arytenoid cartilages were found quite edematous. The laryngoscopic diagnosis was that of tuberculosis. A case of advanced pulmonary tuberculosis with laryngeal involvement showed swelling of the arytenoid region, with fragmentation of the ossified laryngeal cartilages and more or less general distortion of outline (Fig. 23).

Laryngeal Diphtheria.—We have had no acute cases of laryngeal diphtheria in our series, but several chronic cases with stenosis. In one case we noticed a rather advanced ossification of the laryngeal cartilages for the age of the individual, who was only 25 years of age (Fig. 24). This confirms Taylor's observation that chronic infection predisposes one to excessive bone formation in the laryngeal cartilages.

The Trachea.—We have had, so far, very little experience in the diagnosis of primary lesions of the trachea, which are known to be rare, but since its outline is so well defined anything encroaching upon its lumen should offer no difficulty in demonstration. Secondary changes as a result of laryngeal affections, such as tracheal stenosis, have been encountered. Alterations in the position and caliber of the trachea have been observed quite frequently, as a result of tumors of the neck, especially those arising from the thyroid. Recently an interesting case came under our observation which showed changes in the tracheal rings with markedly increased ossification of both the laryngeal and tracheal cartilages. We are inclined to attribute these changes to x-ray treatment given for a goiter many years before. Externally the neck shows a high degree of telangiectasis (Fig. 25).

Thyroid Gland.—The normal thyroid gland is not readily differentiated on the roentgenogram. When enlarged, it is recognized as a mass of soft tissue projecting in front of the trachea. The latter is often

displaced laterally by the enlarged thyroid and occasionally forward by retrotracheal thyroid tumors. The presence of calcification in an enlarged thyroid is easily demonstrable.

Lymph Glands.—Tuberculosis of the lymph glands offers no difficulty in the diagnosis provided the glands contain calcified concretions. When they do not, if enlarged, they may be recognized, but their exact nature cannot be determined.

Emphysema of the Neck.—The presence of free air in the tissues of the neck is readily demonstrated by the increased transparency along the fascial planes. Several such cases have come under our observation (Figs. 2 and 3), all due to traumatism of one kind or another.

Foreign Bodies.—The value of the x-ray in the diagnosis of foreign bodies in the throat is so well recognized and so much has been written on the subject that very little can be added. However, while opaque foreign bodies are readily recognized and require no special material for their recognition, non-opaque foreign bodies can be visualized only by having the patient swallow a fluid mixture of an opaque medium such as bismuth, barium, or one of the iodine preparations in oil. These adhere to the foreign body and outline it.

SUMMARY AND CONCLUSION

An historical review of the roentgenologic literature dealing with the neck is given. The x-ray technic is described. The factors found most applicable in this work are: 60 ma.; 70–80 kv.; 6 feet distance; time, 0.5 to 1 second, in the sitting position. The roentgenograms obtained with these factors show a high degree of fine detail of the soft structures.

The roentgen anatomy and physiology are discussed at length, describing the position, shape, size, relation, and contour of the various structures, during inactivity as well as during respiration, phonation, and deglutition. Much use has been made of the Valsalva experiment, which enables one to obtain more contrasting roentgenograms with consequent finer definition in the outline of the soft structures. A number of cases of abnormal changes of the neck and their roentgen characteristics are described. Brief mention is made of the diagnosis of foreign bodies, especially the non-opaque kind which can be rendered opaque by the simple procedure of having the patient swallow an opaque medium. Numerous illustrations are introduced, demonstrating the normal and abnormal conditions of the neck.

BIBLIOGRAPHY

(1) Beck, Carl: Roentgen-ray Diagnosis and Therapy. D. Appleton & Co., 1904.

(2) Tousey, Sinclair: Medical Electricity and Roentgen Rays. W. B. Saunders Co., 1910.

(3) Frankel, E.: Über die Verknöcherung des Menshlichen Kehlkopfs. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1908, **12,** 151.

(4) Scheier, M.: Über die Ossification des Kehlkopfs. Arch. f. mikr. Anat. u. Entwicklungsgeschichte, 1901, p. 59; Schäfer-Passow Beitr., 1910, No. 4, page 3.

(5) Thost, Arthur: Der Normale und Kranke Kehlkopf des lebeden in Röntgenbild. Fortschr. a. d. Geb. d. Röntgenstrahlen, Erganzungsband 31, Hamburg, 1913.

(6) Iglauer, Sam: Value of Roentgenography in Diagnosis of the Larynx and Trachea. Jour. Am. Med. Assn., 1914, **63,** 1827–1831.

(7) Pfahler, G. E.: New Roentgenographic Technic for Study of the Thyroid. Am. Jour. Roentgenol., 1921, **8,** 81–83.

(8) Mosher, H. P.: X-ray Study of Movements of the Tongue, Epiglottis and Hyoid Bone in Swallowing. Laryngoscope, 1927, **37,** 235–262.

(9) Brown, S., and Reineke, H. G.: Roentgenological Studies of the Neck. Am. Jour. Roentgenol. and Rad. Ther., September, 1928, **20,** 208–212.

(10) Idem: Roentgenological Study of Superior and Posterior Mediastinum. Am. Jour. Surg., December, 1930, **10,** 452–468.

(11) Hickey, P. M.: Radiography of Normal Larynx. Radiology, November, 1928, **11,** 409–411.

(12) Hay., P. D., Jr.: The Neck. Annals of Roentgenol. Paul B. Hoeber, Inc., 1930.

(13) Barclay, A. E.: The Normal Mechanism of Swallowing. British Jour. Radiol., 1930, **3,** 534–546.

(14) Idem: Digestive Tract: A Radiological Study of its Anatomy, Physiology, and Pathology. Cambridge Univ. Press, 1933.

(15) Pancoast, H. K.: Roentgenology of the Upper Respiratory Tract, with Especial Reference to the Larynx and Adjacent Structures. Jour. Am. Med. Assn., Nov. 1, 1930, **95,** 1318–1321.

(16) Pancoast, H. K., and Pendergrass, E. P.: Roentgenologic Diagnosis of Diseases of the Upper Respiratory Tract in Children. Am. Jour. Roentgenol. and Rad. Ther., March, 1930, **23,** 241–264.

(17) Pancoast, H. K.: Roentgenology of the Pharynx and Upper Esophagus. Am. Jour. Cancer, February, 1933, **17.**

(18) Jackson, Chevalier L.: The Diagnosis of Laryngeal Disease: Laryngoscopic Appearance Correlated with Roentgenologic Observations. Jour. Am. Med Assn., Nov. 1, 1930, **95,** 1322–1324.

(19) Idem: The Value of Roentgenography of the Neck, with Special Reference to its Use in Diagnosis and Treatment of Laryngeal and Tracheal Obstructions. Ann. Otol., Rhinol., and Laryngol., December, 1936, **45,** 951–968.

(20) PACK, GEORGE T., and CRAVER, L. F.: Tumors of the Larynx and Thyroid: Roentgenographic Study. Arch. Otolaryngol., May, 1931, **13,** 658–675.

(21) GOLDEN, ROSS: Evaluation of Roentgenology in Oto-laryngology; the Larynx. Laryngoscope, December, 1932, **42,** 915–918.

(22) JÖNSSON, G.: Method for Roentgen Examination of the Hypopharynx and Upper Air Passages. Acta Radiol., April 15, 1934, **15,** 125.

(23) HIRSCH, I. S., and BAUM, SAMUEL M.: Roentgen Diagnosis and Treatment for Laryngeal Neoplasm. Laryngoscope, February, 1934, **44,** 144–166.

(24) CHAMBERLAIN, W. E., and YOUNG, B. R.: Ossification (So-called Calcification) of Normal Laryngeal Cartilages Mistaken for Foreign Body. Am. Jour. Roentgenol. and Rad. Ther., April, 1935, **33,** 441–450.

(25) TAYLOR, H. M.: Address of the President. Ann. Otol., Rhinol., and Laryngol., December, 1936, **45,** 1087–1100.

(26) IGLAUER, S., and RANSOHOFF, J. L.: Perforation of Esophagus by Foreign Body. Laryngoscope, 1924, **34,** 821–825.

(27) TUCKER, G.: Retropharyngeal Abscess with Lodgment of Foreign Body in Esophagus: A New Diagnostic Sign of Esophageal Foreign Body. Jour. Am. Med. Assn., 1925, **84,** 511, 512.

(28) MANGES, W. F.: Roentgen Diagnosis of Foreign Bodies in the Esophagus. Am. Jour. Roentgenol. and Rad. Ther., 1927, **17,** 44–50.

(29) Idem: Roentgen Observation of Safety Pins as Foreign Bodies. Arch. Otolaryngol., 1929, **9,** 245–250.

(30) GRANDY, C. C.: A New Method of Making Radiographs of the Cervical Vertebræ in Lateral Position. RADIOLOGY, February, 1925, **4,** 128, 129.

(31) GRATZ, C. M.: Air Injections of the Fascial Spaces; New Method of Soft Tissue Roentgenography: Preliminary Report. Am. Jour. Roentgenol. and Rad. Ther., June, 1936, **35,** 750, 751.

CASE REPORTS AND NEW DEVICES

EXTENSIVE BONE METASTASIS IN CARCINOMA OF THE BREAST

By FREDERICK HARVEY, B.Sc., M.D., F.A.C.S.,
Chicago

Early removal of carcinoma of the breast, followed by deep x-ray therapy and general treatment, helps toward cure and to keep patients alive longer than the employment of only one method. We should avail ourselves of every means to educate the public to seek frequent, thorough examinations, and to obtain medical advice as soon as any abnormal condition or symptom is noted. Since we know that fear is a powerful factor in preventing many persons from consulting a doctor, we do well to explain patiently and explicitly that a policy of putting off the seeking of such examination can result only in letting a tumor, if present, get a head start. If the individual's fears should, happily, prove to be groundless, the sooner they are relieved the better for his general wellbeing.

I report two cases, commenting upon them in conclusion.

Case 1. A. B., white female, unmarried, 39 years of age, first came to my attention in 1926 when she entered the North Chicago Hospital to have a carcinoma of the left breast removed. The operation was a radical one, the left breast with adjacent axillary and supraclavicular lymph glands being removed. The wound healed promptly and the patient made an uneventful recovery. She remained in apparent good health until December, 1929, when "shooting pains" extended to the left hip. Dull in character at first, they became progressively more intense. In the latter part of January, 1930, she was unable to support her weight on the left leg.

She entered Grant Hospital on Feb. 7, 1930.

Except for the above-mentioned mastectomy four years previously, the patient's personal, like her family, history was essentially negative.

Physical examination revealed a moderately well nourished individual. The head, neck, heart, lungs, and abdomen were essentially negative. There was marked tenderness over the left hip. The reflexes appeared to be normal.

The laboratory examination of the blood showed: red blood cells, 4,360,000; white blood cells, 8,000; hemoglobin, 75 per cent, with a normal differential count. The blood calcium was 9.8 mg.: the urine was negative.

Roentgen Examination.—Films of the skull, both femurs, and the pelvis showed some rarefactions and elevations of the calvarium, rarefied areas in the upper third of the left femur, and similar areas in the pelvis. Films made at a later examination showed small areas of rarefaction in the left shoulder and the left scapula.

Clinical Course.—There was a gradual, steady loss of vitality. When the patient entered the hospital she was able to sit up in a wheel chair, but within a few months she was confined to bed. Pain developed in both shoulders, and a marked muscular atrophy from disuse occurred. The metastatic growths were controlled to some extent by x-ray therapy but new growths appeared in the left shoulder and along the lower right ribs. A mass was palpable in the abdomen to the left of the epigastrium, and the liver enlarged. The patient complained of distress in the rectum, but no pathology was found on digital examination.

Treatment.—The patient received nine complete series of deep x-ray treatments, which checked the growths in some areas. Sedatives were necessary to relieve pain; otherwise she received only a general supportive treatment.

Roentgen examination revealed the following developments of the disease: (Feb. 12, 1930) Extensive involvement of the right iliac crest and the right femur; (April 23, 1930) improvement and partial calcareous replacement of rarefied areas in the left femur, upper third; in the skull, the calvarium showed some rarefactions and elevations which were probably extensions of the same process; (April 30, 1930) involvement of the top of the skull, left femur, and crest of the ilium; (April 1, 1931) extensive involvement of the head of the left humerus and scapula and of the first lumbar vertebra; (Dec. 12, 1931) involvement of the top of the cranium, the proximal portion of the left femur, the left humerus, and the scapula.

It is the writer's opinion that the condition was held in check over this period by the intensive course of x-ray treatments given. The patient expired on Dec. 12, 1931. It appears that the treatments helped to control pain, to repress metastatic growths, and to prolong life for one or two years.

Case 2. G. B., white female, unmarried, 61 years of age, was seen in April, 1926, following a fall which had injured her left hip. X-ray examination revealed a pathological fracture of the upper part of the femur through a bone cyst about two inches in diameter.

Physical examination showed a thin, anemic

Dr. Harvey met with sudden and tragic death by accident, before he received proof of his paper.—EDITOR.

Fig. 1.

Fig. 2.

Fig. 1. Case 1. Decalcification of humerus, scapula, and ribs caused by metastatic carcinoma.
Fig. 2. Case 1. Extensive decalcification of the left femur.

Fig. 3.

Fig. 4.

Fig. 3. Case 2. Fracture of the right femur through a large decalcified area, caused by metastatic carcinoma.
Fig. 4. Case 2. Extensive calcification of several large areas in the right femur.

woman. The right breast was normal but there was an ulceration on the left breast two inches in diameter; also, a markedly retracted nipple. There was extensive involvement of

the pectoral and axillary lymph nodes. The patient stated that, three years previously, she had noticed enlargement of the left breast, hardening, and finally ulcerating. A diagnosis of cancer of the left breast was made.

Fig. 5. Case 2. Soft tissue dissected away from right femur, at necropsy, showing extensive calcified areas.

The fracture of the right femur was set and a plaster cast applied. Two months later, x-ray films revealed perfect union, but decalcification was present. A metal splint was applied. On June 19, 1926, the left breast, with adjacent axillary and supraclavicular lymph nodes, was removed by radical operation. The recovery was uneventful, and the incision healed promptly.

X-ray treatments were given over the right thigh, but decalcification continued rapidly and the patient expired on Nov. 3, 1926, following amputation at the right thigh.

COMMENT

Both of these patients delayed too long in coming for operation. In Case 1, though an extensive dissection of the lymphatic glands was performed when the left breast was removed, it is evident that the growth had extended beyond the reach of surgery. It is surprising in view of the other metastases that there were no other symptoms than late pain in the left hip; also, the length of life after these metastases appeared, with spreading of deposits to all parts of the body was notable. X-ray treatments, by checking the growth of the early metastatic deposits, with good care and supportive measures, probably kept this patient alive much longer than would otherwise have been the case, thus giving an opportunity for more distant metastases to occur.

In looking over the literature, many cases of extensive metastatic deposits are noted from primary breast carcinoma. Handley has shown that the extension of these deposits is by lymphatic permeation in many instances, but this does not account for all of them. He discusses the work of Dr. Piney, who states that secondary growths in bone occur only in the red marrow, and he could demonstrate no lymphatic vessels in the bone marrow, though there were many in the periosteum. In the marrow, Dr. Piney found the cancer cells growing in the blood channel with no permeation of the periosteal lymphatics. The point of emergence of the tumor on the surface of the bone corresponded to the place of exit of the veins and he thus concluded that the deposits spread in the blood stream.

Dr. Carnett has observed in cases of secondary deposits in the pelvic bones and in the femur that chains of infected glands can often be traced right through the abdomen from the diaphragm, along the aorta and its branches to the groin. He observes that this retrograde permeation of the trunk lymphatics is a more rapid process than permeation of the small lymphatics of the facial plexus. Carnett has shown by the x-ray that the humerus is often first attacked in the region of its head. He thinks it probable that the bone is reached by permeation along the tributaries of the infected axillary glands, a process which must occur in a relatively early stage of cancer.

BIBLIOGRAPHY

1. Handley: The Origin of Bone Deposits in Breast Cancer. Surg. Clin. No. Am., **7**, 1–6.
2. Carnett: Scirrhous Carcinoma of the Breast with Extensive Metastases. Surg. Clin. No. Am., **7**, 7–30.

3. CLAYTON: Surg. Clin. No. Am., **7**.
4. EVANS and LEUCUTIA: Deep Roentgen-ray Therapy of Mammary Carcinoma. Am. Jour. Roentgenol. and Rad. Ther., **24**, 605–728.
5. ORNDOFF: Carcinoma of the Breast, with Electrical Resection and Radiotherapy. Ill. Med. Jour., January, 1928.

A SIMPLE METHOD OF PREPARATION OF RADIUM MOLDS

By I. MILTON WISE, B.S., M.D., *Mobile, Ala.*

This method is similar to the one used by Dr. Max Cutler in the tumor clinic of Michael Reese Hospital, Chicago, except that I have modified it so that the average radiologist can make these molds without great expense or the use of special equipment.

During treatment of lesions on the skin it is both desirable and many times necessary to treat the lesion for several hours at a time, once or twice a day over a period up to ten days. The multiple application and removal of radium in plaques exposes the operator to a great deal of radiation, especially in an office or small clinic where the operator must prepare, apply, and remove the radium himself. This method, which is a modification of Dr. Cutler's, reduces stray radiation to a minimum. The radium is applied to exactly the same area at each application. The contiguous structures can be more readily protected. Should further treatment become necessary, as in a case of recurrence, the applicator for that individual is already made to receive the radium element.

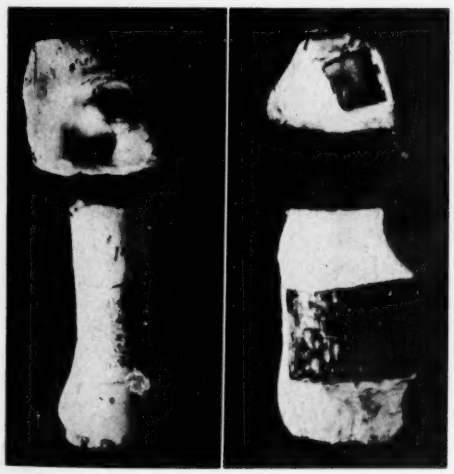


Fig. 1 (*upper*). Cast of lesion on eyelid, and the radium mold. (*Lower*). Cast of lesion on leg, and the radium mold.

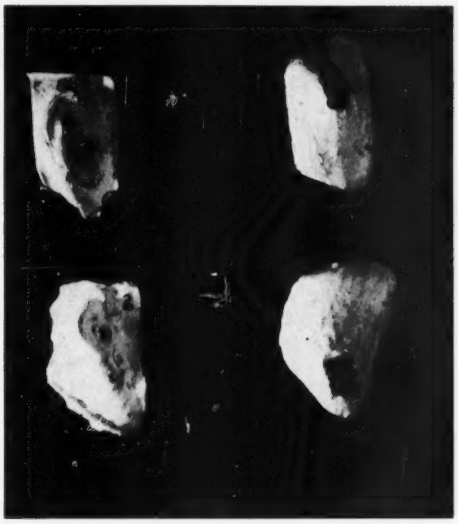


Fig. 2 (*upper*). Cast of lesion on ear and the radium mold. (*Lower*). Cast of lesion on the lobe of the ear and the radium mold.

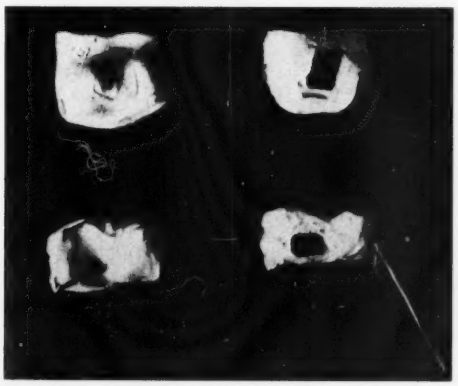


Fig. 3. (*upper*). Cast of the lesion on maxilla and the radium mold. (*Lower*). Cast of the lesion on ala of nose and the radium mold.

Fig. 4. Radiographs of two radium molds to show the relative radiodensity.

Finally, it is an advantage to have an accurate reproduction of the condition at the first examination.

The method is as follows: thin sheets of paraffin or wax are poured to a thickness of about 3 mm. and of various sizes, and allowed to harden. With warm water a sheet is then softened until it becomes quite pliable. This sheet is then accurately molded over the lesion, as well as the surrounding tissue, trying to include some landmark that the finished mold will cover so as to insure the same placement of the mold at each application. Usually the lesion can be seen through the partly hardened wax and its border outlined on the outside of the wax. The paraffin is allowed to harden and is then removed, making a negative of the lesion. On the inside of the negative the outline of the lesion is again traced in the wax. Into this wax mold plaster of Paris is poured and allowed to harden; then the wax is removed. A reproduction of the lesion and the surrounding area, or a positive, is obtained, with the lesion outlined on the plaster. A second negative is made by covering the positive with dental wax, base plate or some pliable material that has no filtration value for radium. This becomes the base of the mold and will be in apposition with the skin. The area to be treated is readily seen and around it is placed a lead box, 1 cm. larger than the lesion and of 2 mm. thickness of lead. All around this lead box is then filled in with plaster of Paris and into it may be placed paper clips or anything to fasten tape to the mold to hold it in place if so desired. Depending upon the distance desired, the box is filled with wax of no filtration value and the radium placed at its predetermined distance. Should additional filtration be wanted, 1 mm. lead can be put in the wax and the radium placed thereon and covered with a little hot wax to hold it in place. Finally the lead box holding the radium is covered with a lead lid, affording further protection to the operator during the application and removal of the mold. This lid may be held in place by the metal clips soldered to the lead box before the plaster is poured or may be held in place by a strip of adhesive tape.

In certain areas, especially about the eye, along the hair line, etc., additional protection may be procured by placing small lead barriers on the base plate before covering it with plaster.

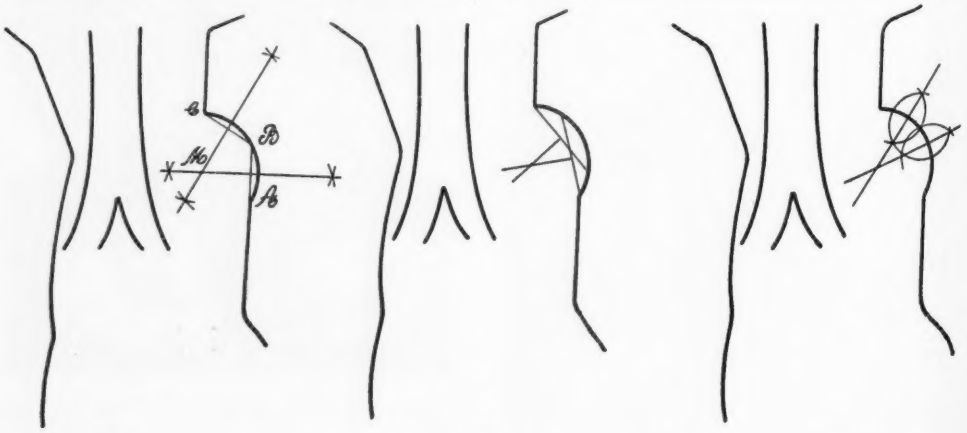
MEASUREMENT OF THE AORTIC DIAMETER BY GEOMETRICAL METHOD

By AGUINALDO LINS, M.D., *Recife, Brazil*

Director of the X-ray Institute Medical School

Modern technics greatly simplify diagnosis. In the exploration of the mediastinal organs, it was teleradiography that allowed Abreu to create the radiogeometry of the mediastinum that will serve as the basis of this difficult chapter of modern semeiology.

The images are changed in different perspectives because the only condition of visibility of the vascular outlines has its anatomical expression in the pulmonary contiguity. The processes of the mensuration of the aortic



I *II* *III*

Figs. 1, 2, and 3.

caliber of Vaquez and Bordet, Lippmann, and Quiring were based on a wrong interpretation of the digitiform shadow thought to be produced by the ascending aorta. Abreu's method (intertracheo-pulmonary mensuration) is less susceptible to mistakes than that of Kreuzfuchs (inter-esophagus-pulmonary measurement).

In 1931 I suggested that one could calculate the diameter of the artery by looking for the center of the aortic button which is the first left higher arch of the mediastinum; finding the center, one gets the radius; doubling the radius, one will have the diameter of the crossing point. To find the center, one can employ one of three following methods:

(*a*) Mark three points in the arch; join these points by means of two pieces of string, and raise a perpendicular in the middle of each of them. The intersection of these perpendiculars is the center (Fig. 1).

(*b*) Trace two strings anywhere on the arch; raise a perpendicular in the middle of each, and the center will be at the meeting of the two perpendiculars (Fig. 2).

(*c*) Choose any point of the curve and trace an arch of an almost complete circle; centering in intersections of this circle with the curve given, describe, with the same radius of the incomplete circle, two arches, through whose intersections pass two straight lines. The meeting of these will define the center (Fig. 3).

After five years I feel myself competent to affirm that experience has given me the conviction that this method allows one in all cases to obtain with mathematical precision the diameter of the aorta.

X-RAYS FROM RADIO TUBES

By H. D. SIMONS, G. L. CLARK, *and* O. C. KLEIN, University of Illinois, *Urbana, Illinois*

The radiographic illustrations which are presented in this article prove that x-rays can be produced for experimental purposes with a unit which can be built for a very small fraction of the cost of installation of a standard x-ray unit. The apparatus consists essentially of a $^1/_{10}$ hp. motor which operates a rotor whose function is to raise the frequency of the current; a set of brushes for conducting the current from the rotor to the block of condens-

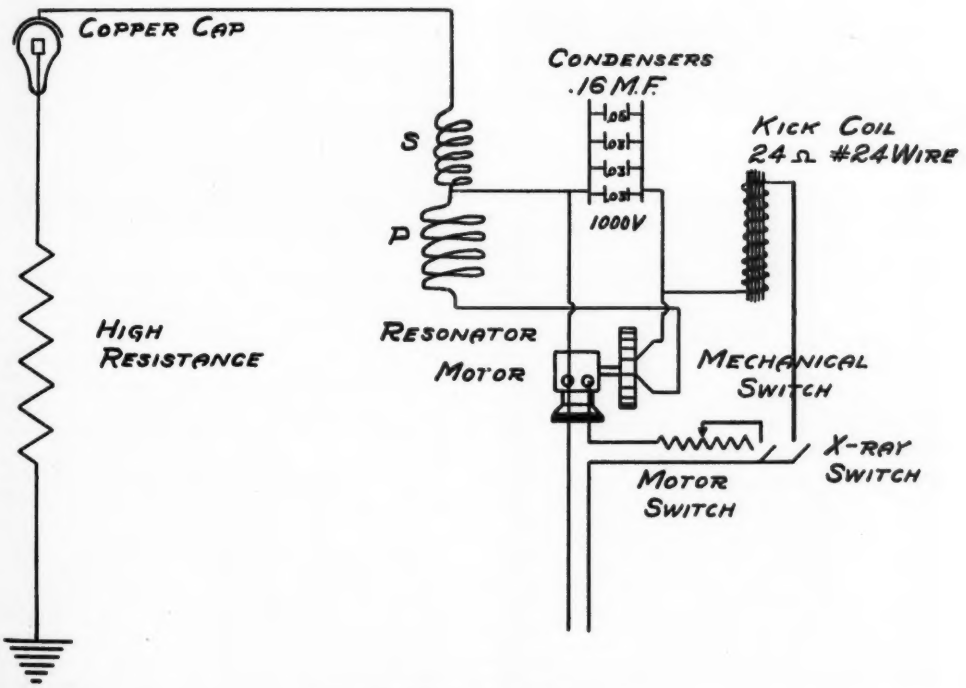


Fig. 1. Schematic plan of apparatus.

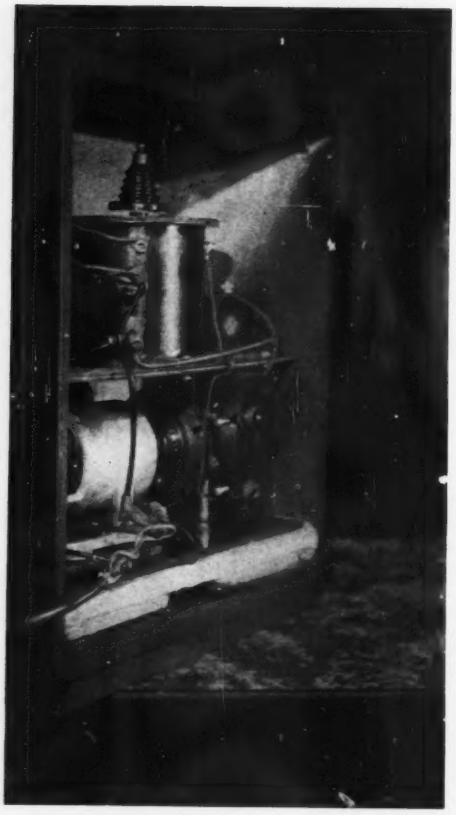


Fig. 2. Photograph of rear view of assembly.

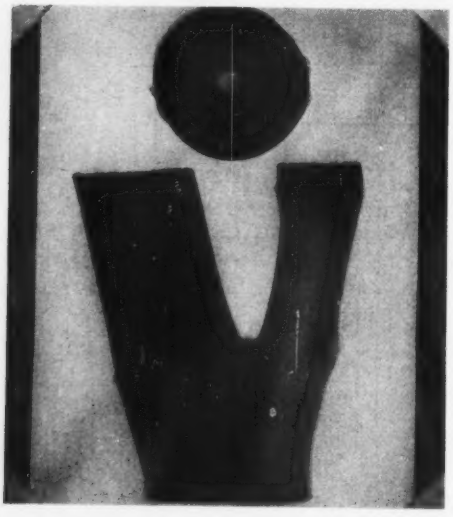


Fig. 3. Elbow and cross-section of young birch tree (one and one-half minute exposure).

Fig. 4. Glass bottle with bakelite top (two-minute exposure).

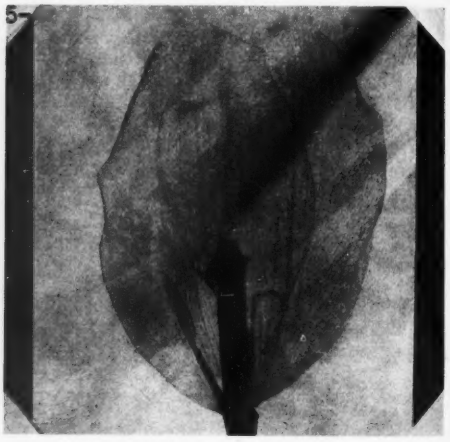


Fig. 5. Full-grown tulip (one-minute exposure).

ers (0.16 MF); a "kick coil" of 24-ohm capacity; a resonator for building up the voltage, and an old 01-A radio tube. The schematic plan of the apparatus is given in Figure 1.

The construction of the apparatus is very simple. A "kick coil" consisting of one and one-quarter pound of No. 24 silk covered wire is wound on a bakelite core five-eighths inch in diameter and three inches long. The purpose of this coil is to excite the primary circuit of an Oudin resonator which consists of six turns of No. 10 cotton-covered space-wound wire which is connected to two ounces of No. 32 double cotton-covered space-wound wire which composes the secondary. The primary of the resonator is further excited by

the use of a block of condensers which are connected as indicated in Figure 1. The tube used is of the familiar 01-A type, the four prongs being shorted. A copper cap is placed on the tube and connected to the resonator, the prongs being connected to a suitable high resistance. The rotor used to raise the frequency of the current is driven by a $^1/_{10}$ hp. variable-speed motor and consists of a brass disk four inches in diameter and one-half inch thick in which are placed at one-inch spaces, one-quarter inch mica segments. A rear view of the assembly is shown in Figure 2. Its total weight is 28 pounds.

The machine, when in operation, will produce a beam of x-rays easily detected for a distance of several feet in all directions. With r meter measurements the writers determined the intensity of the rays to be three-fourths of an r unit per minute, at a distance of three feet.

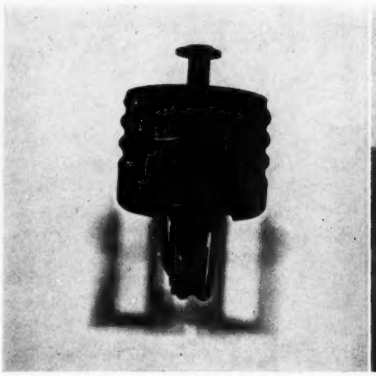


Fig. 6.

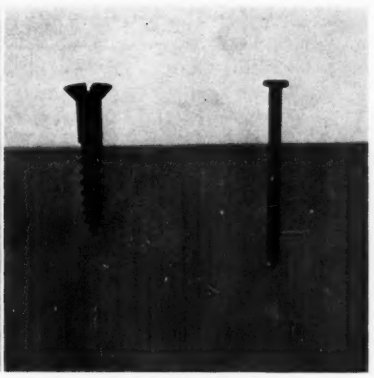


Fig. 7.

Fig. 6. Electric light plug-in socket (four-minute exposure).
Fig. 7. Nail and screw in one and one-half inch pine (one-half minute exposure).

EPILEPSY ASSOCIATED WITH PITUITARY DISTURBANCE: RESPONSE TO X-RAY THERAPY[1]

By BERNARD SELIGMAN, M.D., *Brooklyn, N. Y*

From the Out-patient Department, Kings County Hospital

Cushing (1) and others have reported epileptic seizures associated with lesions of the pituitary gland. Good results were obtained following the administration of gland substance whether or not the lesions were accompanied by tumors. The following case suggests the employment of x-ray therapy in epileptic seizures associated with lesions of the pituitary gland. This would be especially advantageous in those associated with tumors that did not cause marked focal pituitary symptoms.

[1] Read before the New York Endocrinological Society, April 28, 1937.

M. F., born Nov. 9, 1911, was first seen in the Kings County Hospital Out-patient Department on Oct. 21, 1933, at the age of 21. She complained of the presence of soft down on the upper lip and chin for ten years, getting worse in the past five or six years, and stoutness. She was always inclined to be stout. Although she did not complain of fits, she stated that she had had epileptic attacks since the age of ten—from two to four each year. Her mother, who was about the same size and build as the patient, had died of a stroke at the age of 37, two years previously. Her father committed suicide at the age of 40, shortly after the mother's demise. She has three brothers and two sisters alive and well.

Menstruation began at age of 13, is regular every 28 to 30 days, with duration of three or four days, requiring two napkins each day. She has slight pains in the mid-hypogastrium. She states that she goes out with members of the opposite sex and has natural desires, but never has had intercourse. She has occasional coughs with colds, and a rare headache. She had measles as an infant. There is no history of trauma. Her weight has been constant at about 195 pounds for five or six years. She likes all foods and has no excessive thirst except after salty foods. She drinks six or seven glasses of water daily, one or two glasses of milk, one cup of coffee, and two cups of tea—about 2,500 cubic centimeters a day. She urinates six or seven times a day; there is no excessive amount at each voiding.

Present Illness.—For the past 12 years, when excited, she has had what she calls "fits." She has a heavy, dopy feeling, with inability to concentrate while talking for a short time, and a nervous feeling "inside the stomach" which occurs about one-half hour before an attack. She then lapses into unconsciousness. She froths from the mouth, snores, yells, and kicks her feet. She is unconscious for a variabel period of time, from ten to fifteen minutes on occasion, after which she feels tired and drowsy and then sleeps for several hours. She awakens with a dull headache over the entire head.

Physical Examination.—She is 61 inches tall. Span is 60 $^{3}/_{4}$ inches, lower measurement 31 inches. Her weight is 195 pounds. Blood pressure, 118/80; pulse, 96; temperature 97.8. She is short, moderately obese. Her hair is thick and long. Over the upper lip and chin a moderate collection of soft, downy hair is present. The eyebrows are heavy and coarse. The face is large, with a double chin. The breasts are slightly large with a little more fullness of the right breast; a few scattered hairs are present over the areolar region. Her vision is good; eye grounds are negative; the visual fields on gross confrontation test are not limited. The lower teeth over-ride and the last molars are still hidden. The pharynx is injected. The tonsils are small and cryptic. The tongue is slightly coated. The heart and lungs are negative. The abdomen has no tenderness or masses. She has a tendency to a muchal pad and a marked girdle obesity. The integument over the lower thoracic and upper lumbar back is plicated in three large, distinct folds. The thighs and legs are heavy-set, the buttocks large. The hands and feet are small and stubby, especially the feet. Lunulæ are present in the nails. On rectal examination, the external genitalia are average, the hymen intact, and the cervix small and infantile. The cranial nerves are intact. Motor and sensory systems are negative and there is no Romberg and no past pointing. All the superficial reflexes are slightly hyperactive. No Hoffman or Babinski reflex was elicited. The Weber test is negative. She has a suggestion of a right ankle clonus. The sella turcica is normal in size, type, and shape and shows no evidence of erosion of the anterior clinoid processes. On the film no increased intracranial pressure is seen. The last molars are unerupted. Fluoroscopy of the wrists shows the epiphyses of radius and ulna fused. The distal phalanges are delicate.

Sugar tolerance curve

103 milligrams per cent on a fasting stomach.
110 milligrams per cent one hour later.
118 milligrams per cent two hours later.
118 milligrams per cent three hours later.

Blood cholesterol, 162 milligrams per cent.

Forty c.c. of whole blood two weeks after menstruation shows one normal menstrual cycle in a mouse. The basal metabolic rate was plus 19 per cent.

She was placed on a "degenerative obesity diet" of Langstroth (2) and given $^{1}/_{8}$ grain of thyroid *t.i.d.* for one month. It was discontinued because her pulse rose slightly to 100. She lost 45 pounds, dropping her weight to 150.

On May 18, 1934, she was given 600 r to the right pituitary field[2] and on May 19, 1934, a similar dosage to the left pituitary field through a small portal. This was given with the thought that she might have a basophilic lesion of the pituitary gland accounting for the hirsuties. She was asked to report back in six months but was not seen until February, 1937, when she stated that she had an attack in January, 1936, and another in February, 1936. In other words, she had gone for a period of 20 months without any attacks whatsoever, although she previously had had from two to four attacks each year. There was an interval of two years since her previous attack. She was not cognizant of the fact that this treatment was given for her epilepsy but was under the impression that it was to help her hirsutism and hence did not report for further x-ray treatments. Her hirsutism is still present although improved by electrolysis therapy. She has had no changes in her menses since the therapy and feels much better mentally. She has grown about one-half inch.

SUMMARY

Female, 21, with girdle obesity, increased glucose tolerance, moderate polydipsia and polyuria, hypotension, negative sella turcica, or other evidence of focal pituitary symptoms or signs, diminished female sex hormone in blood, normal blood cholesterol. She had, however, a slightly elevated basal metabolic rate and tachycardia with a moderate hirsutism of the soft, lanugo type. After she was given two doses of 600 r to the pituitary, no seizures occurred, for a period of two years. The clinical picture shows significant factors indicative of a hypopituitary condition with no evidence of a hypophyseal tumor. The course shows presumptive evidence of an amelioration of the "spells" by the use of the roentgen therapy. The signs and symptoms may have been due to a small chromophobe adenoma of the pituitary.

[2] X-ray Therapy Department, Asa B. Friedman, M.D.

REFERENCES

(1) CUSHING: Pituitary Gland and its Disorders. J. B. Lippincott & Co., 1912, p. 351.

(2) LANGSTROTH, L.: Relation of American Dietary to Degenerative Diseases. Jour. Am. Med. Assn., Nov. 23, 1929, **93**, 1607–1613.

THE DIVIDED NAVICULAR OF THE FOOT

By WILLIAM E. ANSPACH, M.D.,
and
E. BLAKE WRIGHT, M.D.,
Chicago

The divided or extra navicular, the true tibiale externum of the foot, a well-recognized anatomical entity as early as 1907 (1), has received relatively little attention in recent x-ray literature and is omitted from most charts indicating extra ossicles or anomalies of the foot. Although it is a rare condition, a brief report would seem in order to call attention to this regular anomaly which is most prone to have a mistaken interpretation on roentgenograms when seen for the first time. The following case seems typical.

CASE REPORT

M. J., female, 25 years of age, a nurse, received an injury to the foot while riding in a taxicab when the car stopped suddenly and the patient slid forward, forcibly flexing her right foot against the back of the front seat. She was taken to the hospital, where it was noticed that the region of the right navicular was prominent. A diagnosis of a sprained ankle was made. Six weeks later a second physician examined the patient and after having roent-

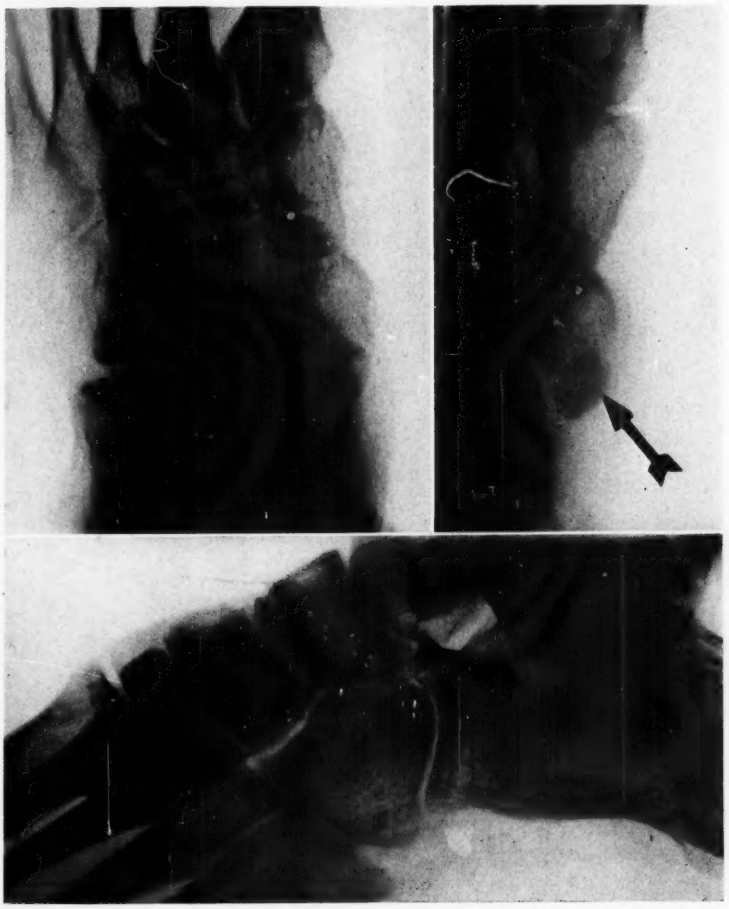


Fig. 1. Normal left foot, oblique, antero-posterior, and lateral views. The true tibiale externum is not seen in the lateral view but is nicely set out in the internal oblique.

genograms made of the foot from different angles, made a diagnosis of a fractured navicular and had a cast applied. The patient suffered little and the cast was removed at the end of two weeks. A few days later the patient reported to one of us (E. B. W.) for a check-up examination. The other (W. E. A.) was requested to make a roentgenographic examination to note progress. Films of the right foot made at different angles showed the navicular divided into two apparently isolated portions (Fig. 2). Each had normal appearing borders, but at the point of contact with each other the surfaces were slightly flattened. The texture of each segment appeared normal and while there did not seem to be a well-formed joint space between them, they presented the appearance of two distinct bones. An anomalous divided navicular was thought to exist, and an examination of the normal left foot showed identical changes (Fig. 1). Through the kindness of the patient and the courtesy of the physician making the earlier examination, we were able to compare roentgenograms made at different periods and found that in all, the texture and contour of the bones were similar.

Fig. 2. Injured right foot (same views as in Figure 1). Note the exact similarity to the uninjured left foot, indicating the presence of a divided navicular and ruling against a fracture.

COMMENT

While the divided navicular of the foot has been occasionally mentioned in the literature, and this condition was beautifully illustrated by Dwight in 1907 (Fig. 3), it has been given little attention since, and demonstrations on roentgenograms have been rare. Although this

condition is infrequently met with, its similarity to a fracture should cause it to be included on working charts. It is the largest regular anomaly of the tarsals and because of having a closer relationship to the regular bones it is more prone to have a mistaken interpretation than the more common extra ossicle, also called the tibiale externum, which is located in the tendon and is usually at some distance from the regular navicular. The *true tibiale externum*, the name given to the mesial portion of the divided navicular, is located at the insertion of the tendon of the tibialis posticus muscle and is fixed in position to its component, which appears to be the regularly formed navicular. The smaller sesamoid of the same name is located out in the tendon of the same tibialis posticus muscle. Because of the prominence on the surface of the foot of the *true* tibiale externum, it would seem to be more exposed to injury than the smaller anomaly.

When roentgenograms of the divided scaphoid are seen for the first time, immediately following an accident, the true tibiale externum should be thought of, but a mistaken diagnosis of a fracture is most likely to be made. Even later, if there has been a painful injury, the same mistake may logically occur. Extremely late, the smooth contour and texture suggests the absence of a fracture and a mistake in the diagnosis should not be repeated. Although linear fractures of the navicular of the foot are rare compared with those of the hand, the fragments at first are sharply defined and are most often seen as counterparts, frequently fitting perfectly together. Later, one of the fragments is almost sure to change in density because of a disturbed circulation, and appear relatively more dense. The contacting surface of the other fragment at the same time tends to become sclerotic. Sometimes cystic changes or additional fractures become evident as time goes on. The absence of all of these changes favors an anomaly, as does the presence of mild or absent symptoms. The diagnosis of an anomaly is, of course, supported when the same change is found in the uninjured foot. While it seems that this anomaly is most likely to be bilateral, too few cases have been recorded up to the present time to warrant one's being sure on this point.

The changes that normally occur in the ossification centers of the navicular during the active period of growth are often erroneously thought to be undergoing necrosis (aseptic necrosis) and are frequently labeled Köhler's disease, even though normal density is present. This occurs because every so often there is a cluster of densities in place of a solitary density indicating the ossification center of the navicular. Consequently in early childhood

Fig. 3. Five scaphoids showing the varying development of the true tibiale externum. (Plate XXVII, Fig. 60, from Variations of the Bones of the Hands and Feet, by Thomas Dwight.)

the scaphoid may vary considerably in appearance, but as a rule, later, the usual picture is seen. Clinically, there may be no evidence of trouble at any time. While the merging several small densities into one most often occurs, infrequently one segment makes an independent development as an extra ossicle. The *true tibiale externum* seems to be formed in this way. It really represents the isolated tuberosity of the navicular and has an origin quite different from the small sesamoid bearing the same name. The latter is the one commonly seen and usually meant when the name "tibiale externum" is used. The *true tibiale externum* shares the duties of the regular one-piece navicular and, therefore, is better described as an *extra navicular*, or, because of the function performed by both parts, the *divided navicular*.

1150 N. State St.

REFERENCE

(1) DWIGHT, THOMAS: Variations of the Bones of the Hands and Feet. Lippincott, 1907.

RADIOLOGICAL SOCIETIES IN THE UNITED STATES

CALENDAR

Meetings Falling Between the Dates of December 15 and January 31.

January 28, 29. Annual meeting of Conference of Eastern Radiologists in Philadelphia.

Editor's Note.—Will secretaries of societies please cooperate with the Editor by supplying him with information for this section.

CALIFORNIA

California Medical Association, Section on Radiology.—Chairman, John D. Lawson, M.D., 1306 California State Bldg., Sacramento; *Secretary,* Karl M. Bonoff, M.D., 1930 Wilshire Blvd., Los Angeles. Meets annually with California Medical Association.

Los Angeles County Medical Association, Radiological Section.—President, D. R. McColl, M.D.; *Vice-president,* John F. Chapman, M.D.; *Secretary,* E. N. Liljedahl, M.D.; *Treasurer,* Henry Snure, M.D. Meets every second Wednesday of month at County Society Building.

Pacific Roentgen Club.—Chairman, Raymond G. Taylor, M.D., 1212 Shatto St., Los Angeles; *Secretary,* L. Henry Garland, M.D., 450 Sutter St., San Francisco.

COLORADO

Denver Radiological Club.—President, W. Walter Wasson, M.D., 246 Metropolitan Bldg.; *Vice-president,* Ernst A. Schmidt, M.D., Colorado General Hospital; *Secretary,* Nathan B. Newcomer, M.D., 306 Republic Bldg.; *Treasurer,* Leonard G. Crosby, M.D., 366 Metropolitan Bldg. Meets third Tuesday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Chairman, Kenneth K. Kinney, M.D., 29 North Street, Willimantic; *Vice-chairman,* Francis M. Dunn, M.D., 100 State Street, New London; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings twice annually in May and September.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida State Radiological Society.—President, Gerald Raap, M.D., 168 S. E. First St., Miami; *Vice-president,* H. O. Brown, M.D., 404 First Nat'l Bank Bldg., Tampa; *Secretary-Treasurer,* H. B. McEuen, M.D., 126 W. Adams St., Jacksonville.

ILLINOIS

Chicago Roentgen Society.—President, David S. Beilin, M.D., 411 Garfield Ave.; *Vice-president,* Chester J. Challenger, M.D., 3117 Logan Blvd.; *Secretary-Treasurer,* Roe J. Maier, M.D., 7752 Halsted St. Meets second Thursday of each month, September to May, except December.

Illinois Radiological Society.—President, Ivan Brouse, M.D., 316 W. State, Jacksonville; *Vice-president,* Cesar Gianturco, M.D., Carle Hospital Clinic, Urbana; *Secretary-Treasurer,* Edmund P. Halley, M.D., 968 Citizens Bldg., Decatur. Meetings quarterly by announcement.

Illinois State Medical Society, Section of Radiology.—President, Roswell T. Pettit, M.D., 728 Columbus St., Ottawa; *Secretary,* Ralph G. Willy, M.D., 1138 N. Leavitt St., Chicago.

INDIANA

Indiana Roentgen Society.—President, J. N. Collins, M.D., 23 E. Ohio St., Indianapolis; *President-elect,* Stanley Clark, M.D., 108 N. Main St., South Bend; *Vice-president,* Juan Rodriguez, M.D., 2903 Fairfield Ave., Fort Wayne; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, Marcus Ostro, M. D., 1810 Eutaw Place; *Secretary,* H. E. Wright, M.D., 101 W. Read St. Meetings second Tuesday of each month.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President, C. C. Birkelo, M.D., Herman Keifer Hospital; *Vice-president,* E. W. Hall, M.D., 10 Peterboro St.; *Secretary-Treasurer,* E. R. Witwer, M.D., Harper Hospital. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society Bldg.

Michigan Association of Roentgenologists.—President, J. C. Kenning, M.D., 1536 David Whitney Bldg., Detroit; *Vice-president,* A. W. Chase, M.D., 133 Toledo St., Adrain; *Secretary-Treasurer,* C. S. Davenport, M.D., 609 Carey St., Lansing.

MINNESOTA

Minnesota Radiological Society.—President, Walter H. Ude, M.D., 78 S. 9th St., Minneapolis; *Vice-president,* Leo G. Rigler, M.D., University Hospitals, Min-

neapolis; *Secretary-Treasurer*, Harry Weber, M.D., 102 Second Ave., S. W., Rochester. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—President, L. G. Allen, M.D., 907 N. 7th St., Kansas City, Mo.; *Secretary*, Ira H. Lockwood, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Joseph C. Peden, M.D., 634 N. Grand Blvd.; *Secretary*, W. K. Mueller, M.D., 607 N. Grand Blvd. Meetings fourth Wednesday of each month.

NEBRASKA

Nebraska Radiological Society.—President, E. W. Rowe, M.D., 128 N. 13th St., Lincoln; *Secretary*, D. Arnold Dowell, M.D., 117 S. 17th St., Omaha. Meetings first Wednesday of each month at 6 P.M. in Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *President*, Frank E. Wheatley, M.D., 520 Beacon St., Boston; *Secretary*, E. C. Vogt, M.D., 300 Longwood Ave., Boston. Meetings third Friday of each month from October to May, inclusive, usually at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, J. D. Tidaback, M.D., 382 Springfield, Summit; *Vice-president*, Milton Friedman, M.D., Newark Beth Israel Hospital, Newark; *Secretary*, P. S. Avery, M.D., 546 Central Ave., Bound Brook. Meetings at Atlantic City at time of State Medical Society, and Midwinter in Newark as called by president.

NEW YORK

Brooklyn Roentgen Society.—President, Albert Voltz, M.D., 115–120 Myrtle Avenue, Richmond Hill; *Vice-president*, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts., Brooklyn; *Secretary-Treasurer*, E. Mendelson, M.D., 132 Parkside Ave., Brooklyn. Meetings first Tuesday in each month at place designated by president.

Buffalo Radiological Society.—President, John Barnes, M.D., 875 Lafayette Ave.; *Vice-president*, W. L. Mattick, M.D., 290 Highland Drive; *Secretary-Treasurer*, J. S. Gian-Franceschi, M.D., 610 Niagara Street. Meetings second Monday evening each month.

Central New York Roentgen-ray Society.—President, W. E. Achilles, M.D., 60 Seneca St., Geneva; *Vice-president*, M. T. Powers, M.D., 250 Genesee St., Utica; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings held in January, May, and October as called by Executive Committee.

Long Island Radiological Society.—President, David E. Ehrlich, M.D., 27 W. 86th St., New York City; *Vice-president*, H. Koiransky, M.D., 43–37 47th St., Long Island City; *Secretary*, S. Schenck, M.D., 115 Eastern Parkway, Brooklyn; *Treasurer*, Moses Goodman, M.D., 45–01 Skillman Ave., Long Island City. Meetings third Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, E. F. Merrill, M.D., 30 W. 59th St., New York City; *Vice-president*, I. W. Lewis, M.D.; *Secretary*, H. K. Taylor, M.D., 667 Madison Ave., New York City; *Treasurer*, R. D. Duckworth, M.D., 170 Maple Ave., White Plains. Meetings third Monday evening each month at Academy of Medicine.

Rochester Roentgen-ray Society.—Chairman, Joseph H. Green, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

Society of Radiological Economics of New York.—President, Albert L. Voltz, M.D., 115–120 Myrtle Ave., Richmond Hill; *Vice-president*, M. M. Pomeranz, M.D., 911 Park Ave., New York City; *Secretary*, W. F. Francis, M.D.; *Treasurer*, Theodore West, M.D., United Hospital, Port Chester. Meetings first Monday evening each month at McAlpin Hotel.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Cleveland Radiological Society.—President, North W. Shetter, M.D., Lakewood City Hospital, Lakewood; *Vice-president*, John Heberding, M.D., St. Elizabeth's Hospital, Youngstown; *Secretary-Treasurer*, Harry Hauser, M.D., Cleveland City Hospital, Cleveland. Meetings at 6:30 P.M. at Cleveland Chamber of Commerce Club on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President*, George Benzing, M.D., St. Elizabeth Hospital, Covington, Ky.; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St., Cincinnati, Ohio. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, Sydney J. Hawley, M.D., Geisinger Memorial Hospital

Danville; *First Vice-president*, William J. McGregor, M.D., 744 Franklin Ave., Wilkinsburg; *Second Vice-president*, Oscar M. Weaver, M.D., 12 S. Main St., Lewistown; *Secretary-Treasurer*, Lloyd E. Wurster, M.D., 416 Pine St., Williamsport; *President-elect*, Charles S. Caldwell, M.D., 520 S. Aiken Ave., Pittsburgh. Annual meeting, May, 1938. Exact date and place to be decided.

Philadelphia Roentgen Ray Society.—President, Thomas P. Laughery, M.D., Germantown Hospital; *Vice-president*, Elwood E. Downs, M.D., Jeans Hospital, Fox Chase; *Secretary*, Barton H. Young, M.D., Temple University Hospital; *Treasurer*, R. Manges Smith, M.D., Jefferson Hospital. Meetings first Thursday of each month from October to May, Thompson Hall, College of Physicians, 19 S. 22nd St., 8:15 P.M.

The Pittsburgh Roentgen Society.—President, F. L. Schumacher, M.D., Jenkins Arcade; *Secretary*, H. N. Mawhinney, M.D., Mercy Hospital. Two Fall and two Spring meetings at time and place designated by president.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, Robert B. Taft, M.D., 105 Rutledge Ave., Charleston; *Secretary-Treasurer*, Hillyer Rudisill, M.D., Roper Hospital, Charleston. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee State Radiological Society.—President, H. S. Shoulders, M.D., 246 Doctors Bldg., Nashville; *Vice-president*, S. S. Marchbanks, M.D., 508 Medical Arts Bldg., Chattanooga; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Radiological Society of Virginia.—President, Fred M. Hodges, M.D., 100 W. Franklin St., Richmond; *Vice-president*, L. F. Magruder, M.D., Raleigh and College Aves., Norfolk; *Secretary*, V. W. Archer, M.D., University of Virginia Hospital, Charlottesville.

WASHINGTON

Washington State Radiological Society.—President, H. E. Nichols, M.D., Stimson Bldg., Seattle; *Secretary*, T. T. Dawson, M.D., Fourth and Pike Bldg., Seattle. Meetings fourth Monday of each month at College Club.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE PRACTICE OF RADIOLOGY IN THE HOSPITAL

A DISCUSSION OF THE PROPOSED SEPARATION OF THE X-RAY EXAMINATION INTO "TECHNICAL" AND "PROFESSIONAL" PORTIONS

Prepared by the Executive Committee of the Pacific Roentgen Club

Genesis.—The immediate cause for the consideration of this problem is the desire on the part of hospitals to include x-ray and clinical laboratory work along with standard bed care in hospitalization insurance plans. The inclusion of the services of the radiologist in such plans of insurance places the hospital in the position of attempting to practise medicine. Desiring to circumvent such illegal practice it occurred to some hospital superintendents to separate the x-ray examination, and thereby the x-ray charges, into two parts, a so-called technical part and a professional part. They proposed to furnish the first along with and as a part of hospitalization, and to furnish the second in a haphazard manner by "permitting" the roentgenologist to interpret the films (and charge therefor) when and if called in consultation. The root of the problem, therefore, lies in the peculiar relationship between hospitals and roentgenologists.

Problem of Dual Interest.—It is perfectly obvious that there are two interests involved in the practice of roentgenology in a hospital. The hospital has an investment in equipment and space, and it sometimes provides technical and stenographic services and supplies to the department. It thus has a definite interest in the money to be collected. On the other hand, the physician practising roentgenology practises his specialty with the use of the equipment and personnel, and, having to earn his living thereby, also has an interest in the money collected.

Division of Dual Interest.—It would seem logical on superficial examination of the subject to divide the fee for x-ray service into two parts, one to cover overhead and one to cover professional service. The difficult problem is where to divide the examination and the fee. Some hospitals claim that it is a hospital procedure up to the point of interpretation, that they can produce roentgenograms without any but lay help; others, having tried this plan, realize that the production of adequate roentgenograms requires more than lay help, that it is truly a professional or professional technical procedure (just as operative surgery, regarded by some as a technical procedure, is really a professional technical procedure). The following arguments are submitted to show that the hospital actually has no interest beyond the provision of proper space and equipment, and, in some instances, materials, and personnel, *and actually should not be allowed to attempt the production of roentgenograms without the services of the roentgenologist.* Fluoroscopic examinations and roentgen diagnosis are assumed, without argument, to be medical procedures.

HOSPITALS SHOULD NOT PRODUCE ROENTGENOGRAMS

Firstly, because the technical work of producing a roentgenogram is a medical procedure.

(*a*) It involves the penetration of the human body by a very dangerous physical agent. In this sense, it is as much a medical procedure as the administration of drugs intravenously, subcutaneously, or by any way other than the patient's own conscious act.

(*b*) A knowledge of medical anatomy and at least a working knowledge of gross pathology is necessary to properly direct the angles of projection in order to demonstrate the various parts involved, and in some cases a knowledge of diseases is required really to know what is to be shown.

(*c*) Medical judgment is required to decide the adequacy or inadequacy of the films obtained.

(*d*) The making of films is part of the examination of ill, often seriously ill, persons, and thus should be under the immediate direction of a physician (roentgenologist).

The statement that the technical side of roentgenography is not a medical procedure originates most frequently from those who are not in close contact with x-ray offices or hospital departments wherein they would see readily how often the roentgenologist is consulted by the technical staff on various cases. When a roentgenologist makes the statement he always assumes medical supervision. Any act that requires medical supervision is *per se* a professional act.

Secondly, because it is not possible to entrust the entire examination to a lay technician, even though we grant that some lay technicians can do a great deal of the work adequately. Credit should be given to roentgenologists that they have been able to train so well relatively inexpensive assistants and thereby lower the cost of radiographic work.

(*a*) Just as many surgeons' nurses take care of many of the routine surgical dressings and in many of the hospitals assist at operations, but are not allowed to do these things except under supervision, so x-ray technicians may do many technical procedures, but they should be under the supervision and direct control of a physician responsible for these procedures.

(*b*) Any case deviating from the routine requires a medical opinion from a roentgenologist as to whether more studies are needed to elucidate the problem. The value of most roentgenologic departments varies directly with the amount of time and supervision given to it by the roentgenologists.

(*c*) Such a procedure artificially separates the method of examination from the interpretation of results. This sometimes causes serious misunderstandings and mistakes. The proper balance between radiographic and fluoroscopic work can be maintained only when the radiologist is present to make the decision.

(*d*) Lay controlled departments have proved unsatisfactory.

Thirdly, because the analogy between surgery and x-ray which has been advanced very often shows the true situation. In surgery, the hospital provides operating rooms, instruments, and nurses but does not attempt to use these instruments. In some medical departments, the hospital provides blood-pressure apparatus, stethoscopes, and ophthalmoscopes, but does not attempt to use them. In the x-ray department, by comparison, the hospital may provide x-ray apparatus, rooms, technicians, and clerical assistants but should not use them without medical supervision and, therefore, should not attempt to produce roentgenograms.

Problem of Specialization.—Granting all of the above, it could be argued that the attending physician should be able to direct the x-ray examination. The fact remains however, that, with few exceptions, he is not able to do so. If he were so able, roentgenology as a specialty would not have developed. The average conscientious physician or surgeon will admit his inability to direct the entire x-ray examination. X-ray technic in theory and in practice is so specialized that it is not possible to train all physicians in it. Good hospitals do not allow any but qualified surgeons to operate in the surgery: no more should they allow any but qualified roentgenologists to operate in the department of roentgenology.

It might be argued that many of the simpler procedures could be done by a lay technical staff directed by the general practitioner. The fallacy of this is well shown by the average run of films from hospitals in small towns where this is done by necessity.

It is self-evident that if men of any talent are to be attracted to the field of roentgenology, so that it can continue to advance, both for the improvement of diagnostic medical practice and for the general good of humanity, there must be sufficient rewards to make it attractive. The surgeon is able to do many minor things without charge because he can collect large fees for his technical (operative) work. The roentgenologist is not able to collect any such large fees and, therefore, must make small amounts from each examination. If the minor examinations were to be removed from his category, he would, in order to exist, have to charge more for the major examinations.

One practical difficulty in dividing the fee for x-ray work is that with charges of such small denomination, the patients would object to paying two fees. Presuming that they paid the hospital fees first, they would assume that they had paid for their roentgenologic examination and would balk at paying an interpretation or diagnostic charge when this was submitted by the doctor. Neither the lay public nor the medical profession have been educated to the two-fee idea.

Conclusions.—The x-ray examination is, and always has been, fundamentally a medical procedure. Roentgenology as a science is still in its infancy. The medical profession as a whole should not stand by idly while hospitals or short-sighted lay interests try to take over this phase of medical practice under the guise of calling it a technical procedure. The actual operation in surgery is in the same sense a technical procedure; auscultation and percussion are technical procedures; cystoscopic examinations are technical procedures. If all of these are separated from physicians, how will medicine, including radiology, advance or even maintain its present position? X-ray technicians must be trained by physicians. Who will train them when the specialty of radiology no longer exists? This whole proposal of artificial division is a retrograde step.

Everyone agrees that the hospital should have a great interest in its equipment, in its space, and in its personnel, but here the interest ceases. They can charge for the materials, interest on investment, salaries, and rental but not for the production of roentgenograms. If the hospital is able to hold out as part of the bait for its insurance policy only the strictly hospital portion of the x-ray examination and if the patient has to pay the recognized roentgenologist for the rest, the bait will not be big enough. There seem to be better ways of protecting the hospital's interest than the division of the medical x-ray examination into two artificial portions. One of these is the maintenance of the quality and soundness of the medical care practised in the hospital; the other is the recognition of the rights of the medical profession, who in the final analysis actually make the hospital what it is. . . a living institution for the care of the sick *in the hospital.*

COMMUNICATIONS

THE AMERICAN BOARD OF RADIOLOGY

At the annual meeting of the American Board of Radiology, held in Atlantic City, June, 1937, the following requirements and recommendations as to professional training were adopted:

The purpose of this report is to outline the method or methods which are recommended for graduate training in radiology. The specific requirements to which the Board of Radiology is committed at present are:

(*A*) Professional Education[1]
- (1) Graduation from a medical school of the United States or Canada, recognized by the Council on Medical Education and Hospitals of the American Medical Association.
- (2) Completion of an internship of not less than one year in a hospital approved by the same Council.
- (3) Three years' training in radiology or sufficient experience in lieu thereof.

(*B*) Special Training (to be effective after Jan. 1, 1940)
- (1) A period of study after the internship of not less than three years in an institution or radiological department recognized by the same Council and the Board of Radiology as competent to provide a satisfactory training in the field of radiology, or equivalent training acceptable to the Board.
- (2) This period of specialized preparation shall include:
  - (*a*) Graduate training in pathologic anatomy, radiophysics, and radiobiology;
  - (*b*) An active experience of not less than twenty-four months in a radiological department recognized by the Board and the Council as capable of providing satisfactory training;
  - (*c*) Examination in the basic sciences of radiology as well as in the clinical aspects thereof.

In the final analysis the most important element in adequate radiologic training is not the school, nor the content or arrangement of the course, but the instructor. He should be endowed with the ability not only to teach but also to inspire, to stimulate, and to impart by example those principles and that attitude of mind conducive to the best practice of radiology. Similarly, the future of radiology depends not on the type or formula of the course nor on the accuracy or thoroughness of

[1] In case of an applicant whose training has been received outside of the United States and Canada, the credentials must be satisfactory to the Advisory Board for Medical Specialties.

the instruction, but on the qualification of the candidate for training, and careful selection of candidates is the very foundation of successful education; for an excellent course cannot make a proficient radiologist out of poor material but an apt student may acquire competence despite limitations of opportunity. With this factor in mind, the Board suggests that the proper approach to graduate training in radiology is through a hospital or institutional residency and that the candidate be selected or approved by the radiologist in charge.

There is universal agreement among teachers of radiology with the general principles outlined above, but there is considerable divergence of opinion as to the best manner of executing them, the order in which subjects should be taken up, and the time which should be allotted to the various subdivisions of radiology. Such differences are not only inevitable but also desirable, for radiologic education is still in the developmental stage, and its progress would be hampered by too rigid standardization at this time. Institutions vary as to the character of material at their command, and hence instructors differ in opinion as to the emphasis that should be laid on particular subjects. Because of these differences a precise and detailed plan of instruction that would be appropriate at one institution might be largely inapplicable at another. Thus The American Board of Radiology feels that it is wise to allow generous latitude in the course of training it prescribes and that at present it is inadvisable to list and narrowly define all the subjects that might well be taught or assign definite periods of study for each of them.

Accordingly, the specifications enumerated are broad and flexible, and it will be left to the future to determine what course or combination of courses will produce the best qualified radiologists. Among exceptions to this generalization, however, the Board wishes to stress the importance of pathology as a fundamental science in radiology. Radiologic examination, diagnostic interpretation and treatment rest primarily on concepts of pathologic processes. For this reason the Board feels that at least six months of the first year should be devoted to the study of pathology and pathologic anatomy, with particular emphasis on gross pathology and that of tumors. Much of the required work in other basic sciences can be carried out along with the clinical, and no set period of time or other specification need be established at present: for example, physics can be reviewed during the study of radiotherapy. In general, the Board is of the opinion that the first year should be given to pathology and radiologic technic and toward acquiring the broad radiologic viewpoint, and that the second and third years should be given to the clinical applications of radiology, with at least six months devoted entirely to radiotherapy. Theses, advanced degrees, and original research are outside the province of present requirements.

The following is a list of diplomates of The American Board of Radiology.

DIPLOMATES OF THE AMERICAN BOARD OF RADIOLOGY

November 1, 1937

	Name	Address	Field
1.	Abbott, Hodson A.	New York, N. Y.	Radiology
2.	Abercrombie, Eugene	Knoxville, Tenn.	Roentgenology
3.	Abowitz, Jacob	Los Angeles, Cal.	Roentgenology
4.	Abraham, Arden L.	Minneapolis, Minn.	Radiology
5.	Achilles, William E.	Geneva, N. Y.	Diagnostic Roentgenology
6.	Ackemann, H. W.	Rockford, Ill.	Radiology
7.	Adair, Frank E.	New York, N. Y.	Therapeutic Radiology
8.	Albert, Simon	Providence, R. I.	Radiology
9.	Alexander, F. K.	Philadelphia, Pa.	Radiology
10.	Algin, Sergius V.	Indiana, Pa.	Diagnostic Roentgenology
11.	Allen, B. M.	Wilmington, Del.	Diagnostic Roentgenology
*12.	Allen, Bundy	Tampa, Fla.	Radiology
13.	Allen, Kenneth D. A.	Denver, Colo.	Radiology
14.	Allen, Lewis G.	Kansas City, Kans.	Radiology
15.	Allen, M. Lowry	Philadelphia, Pa.	Radiology

* Deceased.

16.	Allen, William E., Jr.	St. Louis, Mo.	Roentgenology
17.	Alley, Reuben G.	Pittsburgh, Pa.	Diagnostic Roentgenology
18.	Allison, R. G.	Minneapolis, Minn.	Roentgenology
19.	Altman, W. S.	Quincy, Mass.	Radiology
20.	Ames, Forrest B.	Bangor, Me.	Roentgenology
21.	Anderson, W. D.	Memphis, Tenn.	Roentgenology
22.	Andrews, J. Robert	Cleveland, O.	Radiology
23.	Ané, J. N.	New Orleans, La.	Radiology
24.	Anspach, William E.	Chicago, Ill.	Roentgenology
25.	Archer, Vincent W.	University, Va.	Roentgenology
26.	Arens, Robert A.	Chicago, Ill.	Radiology
27.	Arneson, A. N.	St. Louis, Mo.	Therapeutic Radiology
28.	Ashbury, Howard E.	Baltimore, Md.	Radiology
29.	Aspray, Joseph M.	Spokane, Wash.	Radiology
30.	Atkins, S. M.	Waterbury, Conn.	Roentgenology
31.	Aurelius, J. Richards	St. Paul, Minn.	Roentgenology
32.	Avery, Philip S.	New Brunswick, N. J.	Roentgenology
33.	Bachman, M. H.	Youngstown, O.	Roentgenology
34.	Bacon, Ralph D.	Erie, Pa.	Radiology
35.	Bader, E. R.	Cincinnati, O.	Radiology
36.	Bailey, C. O.	Los Angeles, Cal.	Therapeutic Radiology
37.	Bailey, Wilbur	Los Angeles, Cal.	Radiology
38.	Baird, Joseph C.	Eau Claire, Wis.	Roentgenology
39.	Baker, Charles F.	Newark, N. J.	Roentgenology
40.	Baker, Edgar C.	Youngstown, O.	Radiology
41.	Ball, Clarence F.	Rutland, Vt.	Therapeutic Radiology
42.	Ball, Robert P.	New York, N. Y.	Roentgenology
43.	Barfield-Carter, M.	Birmingham, Ala.	Roentgenology
44.	Barker, Walter C.	Philadelphia, Pa.	Radiology
45.	Barker, W. Allen	Petersburg, Va.	Roentgenology
46.	Barnes, John M.	Buffalo, N. Y.	Roentgenology
47.	Barnett, Arthur F.	Eugene, Ore.	Radiology
48.	Barr, Richard E.	Beaumont, Tex.	Therapeutic Radiology
49.	Barrow, S. C.	Shreveport, La.	Radiology
50.	Barth, Earl E.	Chicago, Ill.	Roentgenology
51.	Batchelder, Philip	Providence, R. I.	Roentgenology
52.	Bauer, August A.	Chicago, Ill.	Roentgenology
53.	Baum, Samuel M.	New York, N. Y.	Therapeutic Radiology
54.	Baxter, O. D.	Sumter, S. C.	Radiology
55.	Beals, John A.	Greenville, Miss.	Radiology
56.	Beeler, Raymond C.	Indianapolis, Ind.	Radiology
57.	Beilin, D. S.	Chicago, Ill.	Radiology
58.	Bell, A. L. L.	Brooklyn, N. Y.	Roentgenology
59.	Bell, J. Sheridan	Waterbury, Conn.	Diagnostic Roentgenology
60.	Bell, Joseph C.	Louisville, Ky.	Roentgenology
61.	Bendick, Arthur J.	New York, N. Y.	Radiology
*62.	Benishek, Werner L.	Aurora, Ill.	Roentgenology
63.	Benjamin, Emanuel W.	Providence, R. I.	Radiology
64.	Bennett, James P.	Chicago, Ill.	Roentgenology
65.	Berg, H. Milton	Bismarck, N. D.	Radiology
66.	Berger, Raymond A.	Richmond, Va.	Radiology
67.	Bernath, Gerald J.	Detroit, Mich.	Diagnostic Roentgenology
68.	Bernstein, J. H.	New York, N. Y.	Radiology
69.	Bertin, E. J.	Philadelphia, Pa.	Roentgenology
70.	Besser, Herman	New York, N. Y.	Radiology
71.	Bethea, W. R.	Memphis, Tenn.	Roentgenology
*72.	Betts, Arthur	Spokane, Wash.	Radiology
73.	Birdsall, Edgar	Glens Falls, N. Y.	Roentgenology
74.	Birkbeck, Norman J.	Dayton, O.	Radiology
75.	Birkelo, C. C.	Detroit, Mich.	Roentgenology
76.	Bishop, Paul A.	Philadelphia, Pa.	Radiology
77.	Blackett, Charles W.	Boston, Mass.	Roentgenology
78.	Blaine, Edward S.	Los Angeles, Cal.	Roentgenology
79.	Blake, Henry K.	New York, N. Y.	Roentgenology
80.	Blake, T. W.	Rochester, Minn.	Radiology
81.	Bliss, Gerald D.	Altoona, Pa.	Radiology
82.	Bloom, Arthur R.	Detroit, Mich.	Roentgenology
83.	Bogan, Isabel K.	Brookline, Mass.	Roentgenology
84.	Bogan, Mary E.	Brookline, Mass.	Roentgenology
85.	Bogart, Franklin B.	Chattanooga, Tenn.	Roentgenology
86.	Boice, Ralph H.	Parkersburg, W. Va.	Radiology
87.	Bonnar, James M.	New Bedford, Mass.	Radiology
88.	Bonoff, Karl M.	Los Angeles, Cal.	Diagnostic Roentgenology
89.	Boone, William H.	New York, N. Y.	Roentgenology

* Deceased.

90.	Borman, C. N.	Minneapolis, Minn.	Radiology
91.	Borrelli, Frank J.	New York, N. Y.	Diagnostic Roentgenology
92.	Borzell, F. F.	Philadelphia, Pa.	Radiology
93.	Bouslog, John S.	Denver, Colo.	Radiology
94.	Bovard, Paul G.	Tarentum, Pa.	Diagnostic Roentgenology
95.	Bowen, Carl B.	Oakland, Cal.	Roentgenology
96.	Bowen, David R.	Philadelphia, Pa.	Radiology
97.	Bowie, E. R.	New Orleans, La.	Roentgenology
98.	Bowing, Harry H.	Rochester, Minn.	Therapeutic Radiology
99.	Boyd, James F.	Providence, R. I.	Radiology
100.	Boyes, James G.	Plainfield, N. J.	Roentgenology
101.	Bradley, Robert A.	Atlantic City, N. J.	Radiology
102.	Brams, Julius	Chicago, Ill.	Radiology
103.	Brandenburg, H. P.	Denver, Colo.	Radiology
104.	Braun, Benj. D.	Chicago, Ill.	Radiology
105.	Brennan, Francis J.	Oshkosh, Wis.	Diagnostic Roentgenology
106.	Brenneman, R. E.	Meadville, Pa.	Radiology
107.	Bridenbaugh, J. H.	Billings, Mont.	Radiology
108.	Brittain, Oman R.	Salina, Kans.	Roentgenology
109.	Broeser, Henry V.	Hoboken, N. J.	Diagnostic Roentgenology
110.	Bromer, Ralph S.	Bryn Mawr, Pa.	Radiology
111.	Brooksher, W. R.	Fort Smith, Ark.	Radiology
112.	Brouse, Ivan E.	Jacksonville, Ill.	Roentgenology
113.	Brown, H. O.	Tampa, Fla.	Roentgenology
114.	Brown, Percy	Boston, Mass.	Roentgenology
115.	Brown, Samuel	Cincinnati, O.	Roentgenology
116.	Bruck, Samuel	Philadelphia, Pa.	Radiology
117.	Bryan, Lloyd	San Francisco, Cal.	Roentgenology
118.	Burch, Hobart A.	Elmira, N. Y.	Radiology
119.	Burcham, Thomas A.	Des Moines, Ia.	Radiology
120.	Burdick, Mitchell	Erie, Pa.	Roentgenology
121.	Burgess, Charles J.	Lawrence, Mass.	Radiology
122.	Burnett, H. W.	Dayton, O.	Roentgenology
123.	Butler, Nicholas G.	Hartford, Conn.	Radiology
124.	Butler, P. F.	Boston, Mass.	Radiology
125.	Caldwell, Charles S.	Pittsburgh, Pa.	Roentgenology
126.	Callen, Harold S.	Bradford, Pa.	Radiology
127.	Camp, John D.	Rochester, Minn.	Roentgenology
128.	Campbell, Lloyd A.	Saginaw, Mich.	Therapeutic Radiology
129.	Capp, Charles S.	San Francisco, Cal.	Radiology
130.	Carlson, Glenn D.	Dallas, Tex.	Roentgenology
131.	Carr, Edson W.	Chicago, Ill.	Diagnostic Roentgenology
132.	Carter, Ray A.	Los Angeles, Cal.	Roentgenology
133.	Carty, John R.	New York, N. Y.	Radiology
134.	Case, James T.	Chicago, Ill.	Radiology
135.	Cassidy, Raymund M.	Chicago, Ill.	Roentgenology
136.	Cathcart, John W.	El Paso, Tex.	Radiology
137.	Challenger, Chester J.	Chicago, Ill.	Roentgenology
138.	Chamberlain, W. Edward	Philadelphia, Pa.	Radiology
139.	Chamberlin, George W.	Philadelphia, Pa.	Radiology
140.	Chapman, John F.	Pasadena, Cal.	Roentgenology
141.	Childe, Arthur E.	Montreal, Que.	Diagnostic Roentgenology
142.	Childs, D. S.	Syracuse, N. Y.	Roentgenology
143.	Childs, S. B.	Denver, Colo.	Roentgenology
144.	Chilko, A. J.	New Rochelle, N. Y.	Roentgenology
145.	Christie, Arthur C.	Washington, D. C.	Radiology
146.	Church, John E.	Pontiac, Mich.	Roentgenology
147.	Cilley, Earl I. L.	Bellingham, Wash.	Radiology
148.	Claiborne, E. N.	New York, N. Y.	Radiology
149.	Clapp, Roland D.	West Medford, Mass.	Radiology
150.	Clark, D. M.	Santa Barbara, Cal.	Radiology
151.	Clark, James J.	Atlanta, Ga.	Roentgenology
152.	Clark, Stanley A.	South Bend, Ind.	Radiology
153.	Clark, William T.	Janesville, Wis.	Radiology
154.	Clarkson, Wright	Petersburg, Va.	Radiology
155.	Cleaves, Edwin N.	Boston, Mass.	Diagnostic Roentgenology
156.	Cleghorn, Charles D.	Miami, Fla.	Radiology
157.	Clement, Gage	Duluth, Minn.	Radiology
158.	Cleveland, W. R.	Evansville, Ind.	Radiology
159.	Climan, Max	Hartford, Conn.	Diagnostic Roentgenology
160.	Coate, J. D.	Oakland, Cal.	Radiology
161.	Coe, Fred O.	Washington, D. C.	Radiology
162.	Coffin, Whitman K.	Boston, Mass.	Roentgenology
163.	Cohoon, Carl W.	Bay Shore, N. Y.	Diagnostic Roentgenology
164.	Colcher, A. Edward	Philadelphia, Pa.	Diagnostic Roentgenology

165.	Cole, J. M.	Windsor, Ont.	Roentgenology
166.	Cole, Lewis Gregory	New York, N. Y.	Roentgenology
167.	Cole, Paul F.	Springfield, Mo.	Radiology
168.	Cole, William Gregory	New York, N. Y.	Roentgenology
169.	Coley, Stephen W.	Memphis, Tenn.	Roentgenology
170.	Colgan, William S.	Bridgeport, Pa.	Radiology
171.	Collins, E. N.	Cleveland, O.	Diagnostic Roentgenology
172.	Collins, James N.	Indianapolis, Ind.	Radiology
173.	Collins, John J.	Thomasville, Ga.	Radiology
174.	Cook, Benjamin F.	Rutland, Vt.	Diagnostic Roentgenology
175.	Cook, Carroll E.	Chicago, Ill.	Diagnostic Roentgenology
176.	Cook, Orrin S.	Sacramento, Cal.	Roentgenology
177.	Cook, Philip H.	Worcester, Mass.	Radiology
178.	Cooley, R. M.	Jackson, Mich.	Roentgenology
179.	Copleman, Benjamin	Perth Amboy, N. J.	Radiology
180.	Coray, Q. B.	Salt Lake City, Ut.	Roentgenology
181.	Corcoran, William J.	Scranton, Pa.	Roentgenology
182.	Cornett, George W.	Yakima, Wash.	Roentgenology
183.	Costolow, William E.	Los Angeles, Cal.	Therapeutic Radiology
184.	Covington, E. Eugene	Baltimore, Md.	Therapeutic Radiology
185.	Cowan, Irving I.	Milwaukee, Wis.	Diagnostic Roentgenology
186.	Cowherd, Frank G.	Cumberland, Md.	Roentgenology
187.	Cox, Michael J.	Pittsfield, Mass.	Roentgenology
188.	Crain, C. F.	Corpus Christi, Tex.	Radiology
189.	Cramp, G. W.	Brooklyn, N. Y.	Roentgenology
*190.	Crane, A. W.	Kalamazoo, Mich.	Roentgenology
191.	Crawford, Helen L.	Indianapolis, Ind.	Roentgenology
192.	Crosby, Leonard G.	Denver, Colo.	Radiology
193.	Crossan, John W.	Los Angeles, Cal.	Diagnostic Roentgenology
194.	Crowder, E. R.	Evanston, Ill.	Roentgenology
195.	Cummings, Edson S.	Portland, Me.	Roentgenology
196.	Cunningham, Lester W.	Mandarin, Fla.	Roentgenology
197.	Currin, Francis W.	Brooklyn, N. Y.	Roentgenology
198.	Curtis, Richard C.	Corsicana, Tex.	Diagnostic Roentgenology
199.	Cushway, B. C.	Chicago, Ill.	Radiology
200.	D'Amico, Michael	New Haven, Conn.	Roentgenology
201.	Dahl, H. W.	Des Moines, Ia.	Diagnostic Roentgenology
202.	Dann, David S.	Kansas City, Mo.	Radiology
203.	Dannenberg, Max	Brooklyn, N. Y.	Roentgenology
204.	Danzer, Joseph T.	Oil City, Pa.	Radiology
205.	Dauksys, Joseph	Excelsior Springs, Mo.	Diagnostic Roentgenology
206.	Davidson, S. G.	Bluefield, W. Va.	Roentgenology
207.	Davidson, Sol C.	Rochester, N. Y.	Roentgenology
208.	Davis, Ernest L.	Springfield, Mass.	Roentgenology
209.	Davis, F. M.	San Antonio, Tex.	Diagnostic Roentgenology
210.	Davis, H. E.	Chicago, Ill.	Radiology
211.	Davis, Henry B.	Lancaster, Pa.	Radiology
212.	Davis, Kenneth S.	Los Angeles, Cal.	Roentgenology
213.	Davison, C. O.	Poughkeepsie, N. Y.	Radiology
214.	Davison, R. Winthrop	Trenton, N. J.	Roentgenology
215.	Debbie, Anthony G.	St. Albans, N. Y.	Diagnostic Roentgenology
216.	Decker, Fred H.	Peoria, Ill.	Radiology
217.	Deetjen, Christian	Baltimore, Md.	Radiology
218.	DeGraff, Ralph M.	Buffalo, N. Y.	Diagnostic Roentgenology
219.	DeHollander, William	Springfield, Ill.	Roentgenology
220.	deLorimier, Alfred A.	Ancon, Canal Zone	Radiology
221.	Delario, Anthony J.	Paterson, N. J.	Radiology
222.	Dempster, J. H.	Detroit, Mich.	Diagnostic Roentgenology
223.	Denham, Harry C.	Gloversville, N. Y.	Diagnostic Roentgenology
224.	Derr, John S.	Frederick, Md.	Roentgenology
225.	Desjardins, Anatole	Wilkes-Barre, Pa.	Roentgenology
226.	Desjardins, Arthur U.	Rochester, Minn.	Radiology
227.	Dessen, Edward	Philadelphia, Pa.	Radiology
228.	Dessen, Louis A.	Hazleton, Pa.	Diagnostic Roentgenology
229.	Deweese, E. R.	Kansas City, Mo.	Radiology
230.	Dick, Paul G.	Chicago, Ill.	Roentgenology
231.	Dickinson, J. C.	Tampa, Fla.	Roentgenology
232.	Dixon, George S.	New York, N. Y.	Diagnostic Roentgenology
233.	Donaldson, S. W.	Ann Arbor, Mich.	Roentgenology
234.	Doub, Howard P.	Detroit, Mich.	Radiology
235.	Doughty, William M.	Cincinnati, O.	Radiology
236.	Dowell, Dawson A.	Omaha, Neb.	Radiology
237.	Downing, Robert E.	Terre Haute, Ind.	Radiology
238.	Downs, Elwood E.	Woodbury, N. J.	Radiology

* Deceased.

239.	Drane, Robert	Savannah, Ga.	Roentgenology
240.	Dresser, Richard	Boston, Mass.	Radiology
241.	Duckworth, Roy D.	White Plains, N. Y.	Roentgenology
242.	Duckworth, Willard D.	New Rochelle, N. Y.	Roentgenology
243.	Duffy, James J.	New York, N. Y.	Therapeutic Radiology
244.	Dumas, Charles E.	Worcester, Mass.	Radiology
245.	Dunham, H. Kennon	Cincinnati, O.	Diagnostic Roentgenology
246.	Durrance, Fred Y.	Houston, Tex.	Roentgenology
247.	Dyke, Cornelius G.	New York, N. Y.	Roentgenology
248.	Eastland, William E.	Oklahoma City, Okla.	Therapeutic Radiology
249.	Eastmond, Charles	Brooklyn, N. Y.	Roentgenology
250.	Edeiken, Louis	Philadelphia, Pa.	Radiology
251.	Edstrom, Henry	Dubuque, Ia.	Radiology
252.	Edwards, Harold G. F.	Shreveport, La.	Radiology
253.	Edwards, J. Bennett	Englewood, N. J.	Roentgenology
254.	Egbert, W. E.	Chester, Pa.	Diagnostic Roentgenology
255.	Ehrenpreis, Bernard	Brooklyn, N. Y.	Roentgenology
256.	Ehrlich, David E.	New York, N. Y.	Radiology
257.	Eisen, David	Toronto, Ont.	Diagnostic Roentgenology
258.	Eldridge, Watson W., Jr.	Washington, D. C.	Roentgenology
259.	Eley, Clayton W.	Norfolk, Va.	Roentgenology
260.	Elliott, Frederic E.	Brooklyn, N. Y.	Radiology
261.	Ellis, Ivan G.	Madison, Wis.	Roentgenology
262.	Elward, Joseph F.	Washington, D. C.	Roentgenology
263.	Eneboe, John B.	San Diego, Cal.	Radiology
264.	Enfield, Charles D.	Louisville, Ky.	Radiology
265.	Ericksen, Lester G.	South Bend, Ind.	Radiology
266.	Ernst, Edwin C.	St. Louis, Mo.	Radiology
267.	Erskine, Arthur W.	Cedar Rapids, Ia.	Radiology
268.	Ettinger, Alice	Boston, Mass.	Diagnostic Roentgenology
269.	Evans, Harry D.	Philadelphia, Pa.	Diagnostic Roentgenology
270.	Evans, John	Baltimore, Md.	Roentgenology
271.	Evans, William A.	Detroit, Mich.	Radiology
272.	Eveleth, Fred S.	Concord, N. H.	Roentgenology
273.	Exner, Frederick B.	Seattle, Wash.	Radiology
274.	Farmer, Harry L.	Cleveland, O.	Radiology
275.	Farrell, John T., Jr.	Philadelphia, Pa.	Roentgenology
276.	Faust, J. J.	Tyler, Tex.	Radiology
277.	Favour, Richmond, Jr.	Washington, D. C.	Radiology
278.	Feaster, O. O.	St. Petersburg, Fla.	Radiology
279.	Ferguson, James W.	Pittsburgh, Pa.	Radiology
280.	Feuerstein, Benjamin L.	Bay Shore, N. Y.	Therapeutic Radiology
281.	Fineman, Solomon	New York, N. Y.	Roentgenology
282.	Finkelstein, Arthur	Philadelphia, Pa.	Radiology
283.	Finnegan, James F.	Portsmouth, Va.	Roentgenology
284.	Finney, Guy A.	Topeka, Kans.	Diagnostic Roentgenology
285.	Firor, Whitmer B.	Baltimore, Md.	Radiology
286.	Fisher, J. W.	Pittsburgh, Pa.	Radiology
287.	Fisher, L. F.	South Bend, Ind.	Roentgenology
288.	Flax, Nathan	Cincinnati, O.	Roentgenology
289.	Flinn, F.	Decatur, Ill.	Radiology
290.	Flippin, Eugene L.	Baltimore, Md.	Radiology
291.	Flynn, James M.	Rochester, N. Y.	Radiology
292.	Foley, Joseph M.	Peoria, Ill.	Roentgenology
293.	Folkins, Frank H.	Redlands, Cal.	Roentgenology
294.	Ford, Frances A.	Detroit, Mich.	Radiology
295.	Fort, W. A.	Mare Island, Cal.	Roentgenology
296.	Fortier, Lucien A.	New Orleans, La.	Radiology
297.	Fouts, Roy W.	Omaha, Neb.	Roentgenology
298.	Francis, Herbert C.	Nashville, Tenn.	Roentgenology
299.	Frank, Charles H.	Batavia, N. Y.	Diagnostic Roentgenology
300.	Fray, Walter W.	Rochester, N. Y.	Radiology
301.	Freedman, Eugene	Cleveland, O.	Roentgenology
302.	Freedman, John	Detroit, Mich.	Roentgenology
303.	Freid, Jacob R.	New York, N. Y.	Radiology
304.	French, Gordon S.	London, Ont.	Radiology
305.	Frere, John M.	Chattanooga, Tenn.	Roentgenology
306.	Fricke, Robert E.	Rochester, Minn.	Therapeutic Radiology
307.	Friedland, Henry	New York, N. Y.	Diagnostic Roentgenology
308.	Friedman, Asa B.	Brooklyn, N. Y.	Radiology
309.	Friedman, Harry F.	Boston, Mass.	Radiology
310.	Freidman, Jacob	New York, N. Y.	Roentgenology
311.	Friedman, Lewis J.	New York, N. Y.	Diagnostic Roentgenology
312.	Friedman, Max	New York, N. Y.	Diagnostic Roentgenology

313.	Friedman, Milton	Newark, N. J.	Therapeutic Radiology
314.	Friedman, Murray M.	New York, N. Y.	Radiology
315.	Fruchter, Joseph M.	Philadelphia, Pa.	Radiology
316.	Fugate, Isaac T.	Louisville, Ky.	Radiology
317.	Fulmer, Charles C.	San Francisco, Cal.	Roentgenology
318.	Fulton, Huston F.	Columbus, O.	Diagnostic Roentgenology
319.	Furey, Warren W.	Chicago, Ill.	Radiology
320.	Furst, Nathan J.	Newark, N. J.	Diagnostic Roentgenology
321.	Galanti, Charles P.	Chicago, Ill.	Roentgenology
322.	Garland, L. H.	San Francisco, Cal.	Radiology
323.	Garrett, Leslie M.	Eau Claire, Wis.	Radiology
324.	Gately, Tracy T.	New Orleans, La.	Radiology
325.	Gates, Russell	Minto, N. D.	Roentgenology
326.	Gelehrter, Joseph	Philadelphia, Pa.	Radiology
327.	Gemmell, J. H.	Rochester, Pa.	Roentgenology
328.	George, Arial W.	Boston, Mass.	Roentgenology
329.	Gerber, Isaac	Providence, R. I.	Radiology
330.	Gershon-Cohen, Jacob	Philadelphia, Pa.	Radiology
331.	Geyman, Milton J.	Santa Barbara, Cal.	Diagnostic Roentgenology
332.	Ghrist, David M.	Glendale, Cal.	Roentgenology
333.	Gian-Franceschi, Joseph	Buffalo, N. Y.	Diagnostic Roentgenology
334.	Gianturco, Cesare	Urbana, Ill.	Roentgenology
335.	Giles, Roy G.	San Antonio, Tex.	Roentgenology
336.	Gillies, Carl L.	Cedar Rapids, Ia.	Radiology
337.	Gilmore, W. M.	Stratford, Ont.	Radiology
338.	Gingold, Joseph R.	Meadville, Pa.	Roentgenology
339.	Glover, M. H.	Wichita Falls, Tex.	Radiology
340.	Goin, Lowell S.	Los Angeles, Cal	Roentgenology
341.	Golden, Ross	New York, N. Y.	Roentgenology
342.	Goldman, Leonard B.	Jamaica, L. I., N. Y.	Therapeutic Radiology
343.	Goldsmith, Maurice F.	Pittsburgh, Pa.	Roentgenology
344.	Goldstone, Karl H.	West New York, N. J.	Roentgenology
345.	Goodman, Moses	Brooklyn, N. Y.	Radiology
346.	Goodrich, Murray E.	Toledo, O.	Radiology
347.	Goodwin, Perry B.	Peoria, Ill.	Radiology
348.	Gordon, Donald C.	Scranton, Pa.	Radiology
349.	Gorfinkell, Julius	Pittsburgh, Pa.	Diagnostic Roentgenology
350.	Gorsline, Clarence S.	Battle Creek, Mich.	Roentgenology
351.	Gottlieb, Charles	New York, N. Y.	Diagnostic Roentgenology
352.	Grace, Joseph M.	Eloise, Mich.	Radiology
353.	Grady, Henry W.	Washington, D. C.	Radiology
354.	Graham, Ralph S.	Sacramento, Cal.	Radiology
355.	Granger, Amédée	New Orleans, La.	Radiology
356.	Gray, Horace D.	Memphis, Tenn.	Radiology
357.	Green, Joseph H.	Rochester, N. Y.	Roentgenology
358.	Greenberg, David S.	Steubenville, O.	Roentgenology
359.	Greenberger, Edward D.	McAlester, Okla.	Radiology
360.	Greenfield, Henry	Brooklyn, N. Y.	Radiology
361.	Grier, G. W.	Pittsburgh, Pa.	Radiology
362.	Grimm, Homer W.	Pittsburgh, Pa.	Therapeutic Radiology
363.	Groark, Owen J.	Bridgeport, Conn.	Diagnostic Roentgenology
364.	Groeschel, L. B.	New York, N. Y.	Radiology
365.	Groh, Jean A.	Cleveland, O.	Roentgenology
366.	Groover, Thomas A.	Washington D. C.	Radiology
367.	Grubbe, Emil H.	Chicago, Ill.	Therapeutic Roentgenology
368.	Habbe, J. Edwin	Milwaukee, Wis.	Roentgenology
369.	Hackler, Robert H., Jr.	Washington, N. C.	Roentgenology
370.	Hackney Urban P.	Dallas, Tex.	Radiology
371.	Hadley, Lee A.	Syracuse, N. Y.	Roentgenology
372.	Hall, E. Walter	Detroit, Mich.	Radiology
373.	Hall, Robert C.	Utica, N. Y.	Roentgenology
374.	Hall, Wendell C.	Philadelphia, Pa.	Radiology
375.	Halley, Edmund P.	Decatur, Ill.	Radiology
376.	Hamilton, Charles M.	Nashville, Tenn.	Radiology
377.	Hamilton, W. S.	San Antonio, Tex.	Diagnostic Roentgenology
378.	Hampton, A. O.	Boston, Mass.	Radiology
379.	Hankins, John L.	Johnson City, Tenn.	Roentgenology
380.	Hansen, Cyrus O.	Minneapolis, Minn.	Radiology
381.	Harding, D. B.	Lexington, Ky.	Radiology
382.	Hardy, Clyde C.	Omaha, Neb.	Diagnostic Roentgenology
383.	Hare, Hugh F.	Boston, Mass.	Radiology
384.	Harrell, Henry C.	Texarkana, Tex.	Roentgenology
385.	Harrington, B. D.	Tacoma, Wash.	Radiology
386.	Harrington, Leo A.	Brooklyn, N. Y.	Diagnostic Roentgenology

387.	Harris Clarence P.	Houston, Tex.	Roentgenology
388.	Harris, John H.	Harrisburg, Pa.	Radiology
389.	Harris, Milo T.	Spokane, Wash.	Radiology
390.	Harris, T. T.	Omaha, Neb.	Radiology
391.	Harris, William	New York, N. Y.	Therapeutic Radiology
392.	Hart, William E.	Long Beach, Cal.	Diagnostic Roentgenology
393.	Hartung, Adolph	Chicago, Ill.	Roentgenology
394.	Hasley, Clyde K.	Detroit, Mich.	Radiology
395.	Hatchette Stakely F.	Lake Charles, La.	Radiology
396.	Hauser, Harry	Cleveland, O.	Radiology
397.	Hawley, Sydney J.	Danville, Pa.	Roentgenology
398.	Haworth, Wallace	Portland, Ore.	Radiology
399.	Hay, Percy D., Jr.	Florence, S. C.	Radiology
400.	Heacock, Charles H.	Memphis, Tenn.	Roentgenology
401.	Healy, Thomas R.	Boston, Mass.	Roentgenology
402.	Heatley, John E.	Oklahoma City, Okla.	Diagnostic Roentgenology
403.	Heberding, John	Youngstown, O.	Radiology
404.	Hefke, Hans W.	Milwaukee, Wis.	Radiology
405.	Helminiak, Mesco J.	Buffalo, N. Y.	Diagnostic Roentgenology
406.	Henderson, Samuel G.	Pittsburgh, Pa.	Radiology
407.	Hendricks, Elliott M.	Fort Lauderdale, Fla.	Roentgenology
408.	Hendrickson, Anna R.	Canton, O.	Roentgenology
409.	Henle, Carye-Belle	Newark, N. J.	Roentgenology
410.	Henry, Lucas S.	Syracuse, N. Y.	Roentgenology
411.	Herpel, Frederick K.	West Palm Beach, Fla.	Roentgenology
412.	Herrman, W. G.	Asbury Park, N. J.	Radiology
413.	Herscher, Harry	Hines, Ill.	Radiology
414.	Hess, George H.	Uniontown, Pa.	Roentgenology
415.	Heylmun, Harry H.	Long Beach, Cal.	Diagnostic Roentgenology
416.	Hildreth, R. C.	Kalamazoo, Mich.	Radiology
417.	Hill, Harold A.	San Francisco, Cal.	Radiology
418.	Hill, Walter C.	Cleveland, O.	Roentgenology
419.	Hilt, Lawrence M.	Grand Rapids, Mich.	Roentgenology
420.	Hilton, James M.	Klamath Falls, Ore.	Roentgenology
421.	Hirsch, I. Seth	New York, N. Y.	Radiology
422.	Hocker, Alfred F.	New York, N. Y.	Therapeutic Radiology
423.	Hodes, Philip J.	Philadelphia, Pa.	Radiology
424.	Hodges, Fred J.	Ann Arbor, Mich.	Radiology
425.	Hodges, Fred M.	Richmond, Va.	Radiology
426.	Hodges, Paul C.	Chicago, Ill.	Radiology
427.	Hoffman, William J.	New York, N. Y.	Therapeutic Radiology
428.	Hoffmeier, Frank N.	Hagerstown, Md.	Diagnostic Roentgenology
429.	Holly, Leland E.	Muskegon, Mich.	Roentgenology
430.	Holmes, George W.	Boston, Mass.	Radiology
431.	Holmes, L. P.	Augusta, Ga.	Roentgenology
432.	Holmes, Ralph W.	Chillicothe O.	Roentgenology
433.	Holston, Joel D.	Massillon, O.	Roentgenology
434.	Holt, William	Portland, Me.	Radium Therapy
435.	Hopkirk, C. C.	Santa Monica, Cal.	Roentgenology
436.	Horrigan, Arthur J.	Springfield, Mass.	Roentgenology
437.	Howard, Campbell	New York N. Y.	Radiology
438.	Howard, William P.	Albany, N. Y.	Roentgenology
439.	Howes, William E.	Brooklyn, N. Y.	Radiology
440.	Hubeny, M. J.	Chicago, Ill.	Roentgenology
441.	Huber, Frank	New York, N. Y.	Roentgenology
442.	Hufford, Clarence E.	Toledo, O.	Radiology
443.	Hunt, Howard B.	Omaha, Neb.	Radiology
444.	Hunt, Russell R.	Providence, R. I.	Roentgenology
445.	Hunter, James W., Jr.	Norfolk, Va.	Radiology
446.	Hussey, Frank L.	Chicago, Ill.	Roentgenology
447.	Hutchinson, R. W.	Chelsea, Mass.	Roentgenology
448.	Hutton, Frederick C.	Philadelphia, Pa.	Roentgenology
449.	Hyde, Allan P.	Sharon, Pa.	Roentgenology
450.	Hyde, X. R.	Fort Worth, Tex.	Roentgenology
451.	Hynes, John F.	Wilmington, Del.	Therapeutic Radiology
452.	Hynes, William P.	Washington, D. C.	Therapeutic Radiology
453.	Ikeda, Kano	St. Paul, Minn.	Roentgenology
454.	Illick, H. Earl	New York, N. Y.	Roentgenology
455.	Imboden, Harry M.	New York, N. Y.	Roentgenology
456.	Ingber, Irving S.	San Francisco, Cal.	Radiology
457.	Irwin, W. A.	Detroit, Mich.	Radiology
458.	Ivey, H. B.	Goldsboro, N. C.	Radiology
459.	Jaches, L.	New York, N. Y.	Radiology
460.	Jackson, Byron H.	Scranton, Pa.	Radiology

461.	Jackson, John B.	Kalamazoo, Mich.	Roentgenology
462.	Jacobs, Alexander W.	New York, N. Y.	Therapeutic Radiology
463.	Jacobs, Lewis G., Jr.	Madison, Wis.	Radiology
464.	Jacox, Harold W.	Pittsburgh, Pa.	Radiology
465.	Jahn, Albert G.	Passaic, N. J.	Roentgenology
466.	Jarre, Hans A.	Detroit, Mich.	Radiology
467.	Jenkinson, David L.	Chicago, Ill.	Roentgenology
468.	Jenkinson, E. L.	Chicago, Ill.	Radiology
469.	Jewell, Earl B.	Fort Dodge, Ia.	Roentgenology
470.	Johannesson, Carl J.	Walla Walla, Wash.	Roentgenology
471.	Johns, Erwin W.	Albuquerque, N. M.	Radiology
472.	Johnson, Brantley M.	Chicago, Ill.	Roentgenology
473.	Johnson, Clayton R.	Los Angeles, Cal.	Roentgenology
474.	Johnson, Ellsworth	Winchester, Va.	Roentgenology
475.	Johnson, Jesse B.	Galveston, Tex.	Radiology
476.	Johnson, Sydney E.	Louisville, Ky.	Diagnostic Roentgenology
477.	Johnson, Vincent C.	Ann Arbor, Mich.	Radiology
478.	Johnston, Zoe Allison	Pittsburgh, Pa.	Therapeutic Radiology
479.	Jones, Clifford F.	Cleveland O.	Roentgenology
480.	Jones, Horace C.	Detroit, Mich.	Radiology
481.	Jones, J. William	Pottsville, Pa.	Radiology
482.	Jones, Oscar O.	Shreveport, La.	Roentgenology
483.	Jones, William A.	Kingston, Ont.	Radiology
484.	Judson, Herbert A.	Los Angeles, Cal.	Roentgenology
485.	Judy, William S.	Greenville, S. C.	Radiology
486.	Kabakjian, Armen E.	Lancaster, Pa.	Radiology
487.	Kahn, Max	Baltimore, Md.	Roentgenology
488.	Kalbfleisch, William K.	Wheeling, W. Va.	Roentgenology
489.	Kann, U. S.	Binghamton, N. Y.	Radiology
490.	Kaplan, Ira I.	New York, N. Y.	Therapeutic Radiology
491.	Kaplan, Morris	New York, N. Y.	Diagnostic Roentgenology
492.	Kapo, Peter J.	Mahanoy City, Pa.	Radiology
493.	Kasabach, Haig H.	New York, N. Y.	Radiology
494.	Kautz, Friedrich G.	New York, N. Y.	Roentgenology
495.	Kean, Albert	New York, N. Y.	Therapeutic Radiology
496.	Keddy, Russell A.	Stamford, Conn.	Diagnostic Roentgenology
497.	Keichline, John M.	Huntingdon, Pa.	Radiology
498.	Keith, David Y.	Louisville, Ky.	Radiology
499.	Kelley, Jacob S.	Providence, R. I.	Roentgenology
500.	Kellogg, John O.	San Diego, Cal.	Radiology
501.	Kelly, James F.	Omaha, Neb.	Radiology
502.	Kenning, John C.	Detroit, Mich.	Radiology
503.	Kerby, James P.	Salt Lake City, Ut.	Roentgenology
504.	Kerr, H. Dabney	Iowa City, Ia.	Radiology
505.	Kesmodel, Karl F.	Birmingham, Ala.	Radiology
506.	Kibby, Sydney V.	Los Angeles, Cal.	Diagnostic Roentgenology
507.	Kidder, Frank W.	Los Angeles, Cal.	Diagnostic Roentgenology
508.	Kilby, Walter L.	Baltimore, Md.	Radiology
509.	King, Earl H.	Saratoga Springs, N. Y.	Roentgenology
510.	King, J. Cash	Memphis, Tenn.	Radiology
511.	Kinney, Kenneth K.	Willimantic, Conn.	Roentgenology
512.	Kinney, Lyell C.	San Diego, Cal.	Radiology
513.	Kinney, Mila A. Jackson	Los Angeles, Cal.	Radiology
514.	Kirkland, A. Stanley	St. John, N. B.	Roentgenology
515.	Kirklin, B. R.	Rochester, Minn.	Radiology
516.	Klapproth, Herman	Halstead, Kans.	Roentgenology
517.	Klein, William	New Brunswick, N. J.	Radiology
518.	Klostermyer, L. L.	Warsaw, N. Y.	Diagnostic Roentgenology
519.	Knapp, John C.	Woodhaven, L. I., N. Y.	Radiology
520.	Knight, Russell W.	Brantford, Ont.	Radiology
521.	Koiransky, Gennady H.	Long Island City, N. Y.	Diagnostic Roentgenology
522.	Kolvoord, Theodore	Battle Creek, Mich.	Diagnostic Roentgenology
523.	Kornblum, Karl	Philadelphia, Pa.	Radiology
524.	Kraft, Ernest	New York, N. Y.	Roentgenology
525.	Kuegle, F. H.	Janesville, Wis.	Roentgenology
526.	Kugler, Joseph C.	Jackson, Mich.	Roentgenology
527.	Kuhlman, Fred Y.	Springfield, Ill.	Roentgenology
528.	Kurz, Bernard	Bronx, N. Y.	Diagnostic Roentgenology
529.	Lachmann, Ernst	Oklahoma City, Okla.	Radiology
530.	Lafferty, R. H.	Charlotte, N. C.	Radiology
531.	Lamb, Frank W.	Portland, Me.	Diagnostic Roentgenology
532.	Lampe, Isadore	Ann Arbor, Mich.	Radiology
533.	Landau, George M.	Chicago, Ill.	Roentgenology
534.	Landes, W. L. S.	York, Pa.	Roentgenology

535.	Lang, Theodor	Rockford, Ill.	Radiology
536.	Langan, Paul C.	Akron, O.	Diagnostic Roentgenology
537.	Lange, Sidney	Cincinnati, O.	Radiology
*538.	Langer, Heinz	Pittsburgh, Pa.	Therapeutic Radiology
539.	Langill, Morton H.	Worcester, Mass.	Roentgenology
540.	Lanier, Leon M.	Nashville, Tenn.	Radiology
541.	Lanman, Everett L.	Battle Creek, Mich.	Roentgenology
542.	Lape, C. Pearley	Buffalo, N. Y.	Diagnostic Roentgenology
543.	Larkey, Charles J.	Bayonne, N. J.	Diagnostic Roentgenology
544.	Larkin, Leo P.	Ithaca, N. Y.	Roentgenology
545.	Larsen, William W.	Le Mars, Ia.	Roentgenology
546.	Lattman, Isidore	Washington, D. C.	Radiology
547.	Law, F. M.	New York, N. Y.	Diagnostic Roentgenology
548.	Lawrence, W. S.	Memphis, Tenn.	Radiology
549.	Lawson, John D.	Sacramento, Cal.	Radiology
550.	Leddy, E. T.	Rochester, Minn.	Radiology
551.	Ledoux, Alfred C.	Evanston, Ill.	Radiology
552.	Leef, Edward	San Francisco, Cal.	Radiology
553.	LeFevre, Walter I.	Cleveland, O.	Roentgenology
554.	Lehman, J. S.	Philadelphia, Pa.	Radiology
555.	Leibert, Harry F.	Bethlehem, Pa.	Roentgenology
556.	Lenz, Maurice	New York, N. Y.	Therapeutic Radiology
557.	Leonard, Ralph D.	Boston, Mass.	Roentgenology
558.	Leucutia, T.	Detroit, Mich.	Radiology
559.	Levene, George	Boston, Mass.	Roentgenology
560.	Levi, Irwin P.	Anniston, Ala.	Roentgenology
561.	Levin, Alfred G.	Miami, Fla.	Radiology
562.	Levin, Isaac	New York, N. Y.	Radiology
563.	Le Vine, David	El Dorado, Ark.	Diagnostic Roentgenology
564.	Levine, Samuel	Philadelphia, Pa.	Radiology
565.	Levitin, Joseph	San Francisco, Cal.	Radiology
566.	Levy, Abraham	Brooklyn, N. Y.	Diagnostic Roentgenology
567.	Levyn, Lester	Buffalo, N. Y.	Diagnostic Roentgenology
568.	Lewis, Raymond W.	New York, N. Y.	Diagnostic Roentgenology
569.	Lhevine, Morris B.	Tulsa, Okla.	Roentgenology
570.	Liebman, Charles	Montreal, Que.	Roentgenology
571.	Liljedahl, Elmer N.	Los Angeles, Cal.	Roentgenology
572.	Lingeman, Leslie R.	Rochester, N. Y.	Roentgenology
573.	Lingley, James R.	Boston, Mass.	Radiology
574.	Lipschultz, Oscar	Minneapolis, Minn.	Roentgenology
575.	Litschgi, Joseph J.	Chicago, Ill.	Roentgenology
576.	Littig, L. V.	Madison, Wis.	Radiology
577.	Lochry, Ralph L.	Indianapolis, Ind.	Roentgenology
578.	Lockhart, Reuben H.	Bridgeport, Conn.	Radiology
579.	Lockwood, Ira H.	Kansas City, Mo.	Radiology
580.	Loud, Norman W.	New Britain, Conn.	Diagnostic Roentgenology
581.	Loughery, Thomas P.	Philadelphia, Pa.	Roentgenology
582.	Loverud, Harold I. L.	Manchester, N. H.	Radiology
583.	Lubell, Moses F.	Waterville, Me.	Roentgenology
584.	Lucas, Charles D.	Charlotte, N. C.	Therapeutic Radiology
585.	Lucinian, Joseph H.	Miami, Fla.	Roentgenology
586.	Lutz, Jeremiah F.	York, Pa.	Roentgenology
587.	Lutze, Frederick H.	Brooklyn, N. Y.	Therapeutic Radiology
588.	Lyons, Clinton G.	Hines, Ill.	Diagnostic Roentgenology
589.	MacColl, D. R.	Los Angeles, Cal.	Roentgenology
590.	MacComb, W. S.	New York, N. Y.	Therapeutic Radiology
591.	MacFarland, William J.	Hornell, N. Y.	Roentgenology
592.	McCarthy, Humphrey L.	Boston, Mass.	Roentgenology
593.	McCarthy, Justin E.	Cincinnati, O.	Radiology
594.	McCaw, William W.	Washington, D. C.	Radiology
595.	McClanahan, Charles W.	West Los Angeles, Cal.	Radiology
596.	McClelland, Donald C.	Lafayette, Ind.	Radiology
597.	McClure, C. C.	Nashville, Tenn.	Radiology
*598.	McCormick, Arthur F.	Du Bois, Pa.	Roentgenology
599.	McCormick, H. G.	Laurel, Miss.	Roentgenology
600.	McCormick, Norman A.	Windsor, Ont.	Therapeutic Radiology
601.	McCormick, William M.	Du Bois, Pa.	Roentgenology
602.	McCullough, John F.	Pittsburgh, Pa.	Radiology
603.	McDeed, Winfield, G.	Houston, Tex.	Roentgenology
604.	McDermott, Joseph L.	Kansas City, Mo.	Radiology
605.	McElfatrick, George C.	Wilmington, Del.	Roentgenology
606.	McEuen, Harry B.	Jacksonville, Fla.	Radiology
607.	McGaughey, H. D.	Joplin, Mo.	Radiology
608.	McGee, Harry H.	Savannah, Ga.	Roentgenology

* Deceased.

609.	McGehee, William H.	Fresno, Cal.	Roentgenology
610.	McGlothlan, Arthur B.	St. Joseph, Mo.	Radiology
611.	McGregor, William J.	Wilkinsburg, Pa.	Roentgenology
612.	McGuffin, W. Herbert	Calgary, Alberta	Radiology
613.	McHenry, Rupert K.	Houston, Tex.	Roentgenology
614.	McIntosh, Harriet C.	New York, N. Y.	Roentgenology
615.	McKinney, Joseph T.	Roanoke, Va.	Roentgenology
616.	McNabb, Atholl M.	Ottawa, Ont.	Roentgenology
617.	McNamee, Edgar P.	Cleveland, O.	Roentgenology
618.	McNutt, John R.	Duluth, Minn.	Radiology
619.	McPeak, Clarence N.	Fitchburg, Mass.	Roentgenology
620.	McPeak, Edgar M.	Washington, D. C.	Radiology
621.	Macmillan, A. S.	Boston, Mass.	Diagnostic Roentgenology
622.	Maddox, William H.	Wauseon, O.	Diagnostic Roentgenology
623.	Magruder, L. Freeland	Norfolk, Va.	Radiology
624.	Mahrer, Herbert A.	Cleveland, O.	Roentgenology
625.	Maier, Roe J.	Chicago, Ill.	Radiology
626.	Malcolmson, Patrick H.	Edmonton, Alberta	Radiology
627.	Malone, Leander A.	Terre Haute, Ind.	Radiology
628.	Mandeville, Frederick B.	Richmond, Va.	Radiology
*629.	Manges, Willis F.	Philadelphia, Pa.	Radiology
630.	Marchbanks, S. S.	Chattanooga, Tenn.	Radiology
631.	Marks, Hirsch	New York, N. Y.	Therapeutic Radiology
632.	Marks, Joseph H.	Fall River, Mass.	Roentgenology
633.	Marquis, W. James	Newark, N. J.	Roentgenology
634.	Martin, Charles L.	Dallas, Tex.	Radiology
635.	Martin, Hayes E.	New York N. Y.	Therapeutic Radiology
636.	Martin, James M.	Dallas, Tex.	Radiology
637.	Martin, Thomas W.	Port Arthur, Tex.	Diagnostic Roentgenology
638.	Martin, W. C.	Louisville, Ky.	Roentgenology
639.	Mason, Claude H.	El Paso, Tex.	Diagnostic Roentgenology
640.	Massaro, Alfonso F.	New York, N. Y.	Diagnostic Roentgenology
641.	Masterson, John J.	Brooklyn N. Y.	Roentgenology
642.	Matlack, James A.	Longmont, Colo.	Diagnostic Roentgenology
643.	Matthews, Cora A.	Evanston, Ill.	Roentgenology
644.	Mattick, Walter L.	Buffalo, N. Y.	Radiology
645.	Maver, William W.	Jersey City, N. J.	Roentgenology
646.	Mawhinney, Harvey N.	Pittsburgh, Pa.	Diagnostic Roentgenology
647.	May, Ernst A.	East Orange, N. J.	Radiology
648.	May, Raymond V.	Cleveland, O.	Radiology
649.	May, Robert J.	Cleveland, O.	Radiology
650.	Mayfield, Claud	Long Beach, Cal.	Diagnostic Roentgenology
651.	Meadows, James A.	Birmingham, Ala.	Radiology
652.	Means, Hugh J.	Columbus, O.	Radiology
653.	Medelman, John P.	St. Paul, Minn.	Roentgenology
654.	Meland, Orville N.	Los Angeles, Cal.	Therapeutic Radiology
655.	Meltzer, Samuel L.	Portsmouth, O.	Diagnostic Roentgenology
656.	Mendelson, Emanuel	Brooklyn, N. Y.	Roentgenology
*657.	Menees, Thomas O.	Grand Rapids, Mich.	Radiology
658.	Menville, Leon J.	New Orleans, La.	Radiology
659.	Merchant, Albert K.	Philadelphia, Pa.	Radiology
660.	Merrill, E. Forrest	New York, N. Y.	Roentgenology
661.	Merritt, E. A.	Washington, D. C.	Radiology
662.	Mesirow, Sidney D.	Chicago, Ill.	Roentgenology
663.	Meter, Edward G.	Reading, Pa.	Radiology
664.	Meyer, Keith T.	Evansville, Ind.	Roentgenology
665.	Meyer, William H.	New York, N. Y.	Radiology
666.	Miles, John M.	New Orleans, La.	Diagnostic Roentgenology
667.	Milkman, Louis A.	Scranton, Pa.	Roentgenology
668.	Miller, Harry A.	Baltimore, Md.	Radiology
669.	Miller, Russel F.	Philadelphia, Pa.	Radiology
670.	Millwee, Robert H.	Dallas, Tex.	Radiology
671.	Ming, Charles M.	Okmulgee Okla.	Radiology
672.	Minor, Edward G.	Detroit, Mich.	Diagnostic Roentgenology
673.	Moffatt, F. J.	Medford, Ore.	Diagnostic Roentgenology
674.	Moloney, Albert M.	Boston, Mass.	Roentgenology
675.	Moore, Alexander B.	Washington, D. C.	Radiology
676.	Moore, Claude	Washington, D. C.	Radiology
677.	Moore, Daniel M.	Monroe, La.	Roentgenology
678.	Moore, John J.	San Francisco, Cal.	Radiology
679.	Moore, Paul D.	Muncie, Ind.	Radiology
680.	Moore, Sherwood	St. Louis, Mo.	Radiology
681.	Moore, Vernor M.	Grand Rapids, Mich.	Radiology
682.	Morrison, Murray C.	London, Ont.	Radiology
683.	Morrison, Sidney L.	Boston, Mass.	Roentgenology

* Deceased.

684.	Morse, Russell W.	Minneapolis, Minn.	Roentgenology
685.	Morton, S. A.	Milwaukee, Wis.	Radiology
686.	Moses, Chester D.	Buffalo, N. Y.	Diagnostic Roentgenology
687.	Mosteller, Malcolm	Columbia, S. C.	Radiology
688.	Mostrom, H. T.	Batavia, Ill.	Radiology
689.	Moxness, Bennie A.	Dayton, O.	Diagnostic Roentgenology
690.	Mueller, W. K.	St. Louis, Mo.	Diagnostic Roentgenology
691.	Mulligan, Peter B.	Ashland, Pa.	Roentgenology
692.	Murphy, G. W.	Asheville, N. C.	Roentgenology
693.	Murphy, J. T.	Toledo, O.	Radiology
694.	Myers, Ralph E.	Oklahoma City, Okla.	Radiology
695.	Napper, Marvin L.	Tulsa, Okla.	Roentgenology
696.	Naslund, Ames W.	St. Paul, Minn.	Roentgenology
697.	Nathanson, Louis	Brooklyn, N. Y.	Radiology
698.	Nelson, Peter A.	Chicago, Ill.	Therapeutic Radiology
699.	Nessa, N. J.	Sioux Falls, S. D.	Roentgenology
700.	Newcomer, Nathan B.	Denver, Colo.	Radiology
701.	Newcomet, William S.	Philadelphia, Pa.	Radiology
702.	Newell, Robert R.	San Francisco, Cal.	Radiology
703.	Nichols, B. H.	Cleveland, O.	Radiology
704.	Nichols, Harold E.	Seattle, Wash.	Diagnostic Roentgenology
705.	Noble, Robert P.	Raleigh, N. C.	Roentgenology
706.	Nordin, Gustaf T.	Minneapolis, Minn.	Radiology
707.	O'Bannon, R. P.	Fort Worth, Tex.	Radiology
708.	O'Boyle, Cyril P.	Philadelphia, Pa.	Radiology
709.	O'Brien, Frederick W.	Boston, Mass.	Radiology
710.	O'Connell, Andrew E.	Worcester, Mass.	Roentgenology
711.	O'Neill, John R.	San Francisco, Cal.	Roentgenology
712.	Ochsner, Harold C.	Indianapolis, Ind.	Radiology
713.	Oderr, Charles	Jersey City, N. J.	Roentgenology
714.	Oechsli, Waldo R.	Olive View, Cal.	Diagnostic Roentgenology
715.	Oehlbeck, Luther W.	Clifton Springs, N. Y.	Roentgenology
716.	Ogden, Ralph T.	Hartford, Conn.	Radiology
717.	Olin, Harry	Chicago, Ill.	Roentgenology
718.	Orndoff, B. H.	Chicago, Ill.	Radiology
719.	Orr, Clifford R.	Buffalo, N. Y.	Radiology
720.	Osgood, Herman A.	Boston, Mass.	Roentgenology
721.	Osmond, John D.	Cleveland, O.	Roentgenology
722.	Osmond, Leslie H.	Pittsburgh, Pa.	Radiology
723.	Ossip, Abraham	New York, N. Y.	Diagnostic Roentgenology
724.	Ostro, Marcus	Baltimore, Md.	Roentgenology
725.	Ostrum, Herman W.	Philadelphia, Pa.	Roentgenology
726.	Ourian, Adom K.	New York, N. Y.	Diagnostic Roentgenology
727.	Overgaard, Anders P.	Omaha, Neb.	Radiology
728.	Owen, Arthur K.	Topeka, Kans.	Roentgenology
729.	Owen, Colin C.	San Bernadino, Cal.	Roentgenology
730.	Pack, George T.	New York, N. Y.	Therapeutic Radiology
*731.	Paine Robert	Memphis, Tenn.	Radiology
732.	Pallen, Conde de S.	Rochelle Park, N. J.	Therapeutic Radiology
733.	Palmer, Dorwin L.	Portland, Ore.	Radiology
734.	Pancoast, Henry K.	Philadelphia, Pa.	Radiology
735.	Parker Carl H.	Pasadena Cal.	Roentgenology
736.	Parker, Eugene M.	Houston, Tex.	Roentgenology
737.	Parmelee, B. M.	Bridgeport, Conn.	Radiology
*738.	Parry, Leo D.	Easton, Pa.	Radiology
739.	Paterson, Robert K.	Ottawa, Ont.	Radiology
740.	Paul, Lester W.	Kansas City, Mo.	Radiology
741.	Pawling, Jesse R.	Watertown, N. Y.	Diagnostic Roentgenology
742.	Payton, Frazier J.	Miami Beach, Fla.	Radiology
743.	Peake, John D.	Mobile, Ala.	Radiology
744.	Peck, Willis S.	Ann Arbor, Mich.	Radiology
745.	Peden, Joseph C.	St. Louis, Mo.	Roentgenology
746.	Peirce, Carleton B.	Ann Arbor, Mich.	Radiology
747.	Pendergrass, E. P.	Philadelphia, Pa.	Radiology
748.	Pendergrass, Robert C.	Americus, Ga.	Roentgenology
749.	Pepe, John	Brooklyn, N. Y.	Roentgenology
750.	Percival, Milton F.	Philadelphia, Pa.	Radiology
751.	Perkins, Charles W.	Norwalk, Conn.	Roentgenology
752.	Perkins, Roy S.	Boston, Mass.	Roentgenology
753.	Perlberg, Harry J.	Jersey City, N. J.	Roentgenology
754.	Perley, Arthur E.	Waterloo, Ia.	Radiology
755.	Perry, Gentz	Evanston, Ill.	Radiology

* Deceased.

756.	Perry, Solomon P.	Sayre, Pa.	Radiology
757.	Peters, Anthony E.	Auburn, Me.	Roentgenology
758.	Peters, Chester M.	Canton, O.	Radiology
759.	Peters, Jesse J.	Tuskegee, Ala.	Diagnostic Roentgenology
760.	Peterson, Charles H.	Roanoke, Va.	Roentgenology
761.	Peterson, George E.	Waukesha, Wis.	Radiology
762.	Peterson, V. L.	Charleston, W. Va.	Radiology
763.	Petrie, E. A.	St. John, N. B.	Roentgenology
764.	Pett, Robert G.	Pittsburgh, Pa.	Radiology
765.	Pettit, Roswell T.	Ottawa, Ill.	Therapeutic Radiology
766.	Pfahler, G. E.	Philadelphia, Pa.	Radiology
767.	Pfeffer, Theodore J.	Racine, Wis.	Radiology
768.	Philips, Herman B.	New York, N. Y.	Radiology
769.	Phillips, Clyde C.	Charlotte, N. C.	Radiology
770.	Pierce, Harold J.	Terre Haute, Ind.	Radiology
771.	Pierson, John W.	Baltimore, Md.	Radiology
772.	Pigott, Albert W.	Skillman, N. J.	Diagnostic Roentgenology
773.	Pindell, Merl L.	Los Angeles, Cal.	Diagnostic Roentgenology
774.	Pines, John A.	Orlando, Fla.	Therapeutic Roentgenology
775.	Pirie, A. H.	Montreal, Que.	Radiology
776.	Pitman, James F.	Lake City, Fla.	Roentgenology
777.	Pitts, Thomas A.	Columbia, S. C.	Roentgenology
778.	Plehn, George J.	New York, N. Y.	Diagnostic Roentgenology
*779.	Podlasky, Harry B.	Milwaukee, Wis.	Roentgenology
780.	Pohle, E. A.	Madison, Wis.	Therapeutic Radiology
781.	Pomeranz, Maurice M.	New York, N. Y.	Radiology
782.	Pomeranz, Raphael	Newark, N. J.	Roentgenology
783.	Pomeroy, Lawrence A.	Cleveland, O.	Radium Therapy
784.	Pool, Harry H.	Pontiac, Mich.	Roentgenology
785.	Popoff, Constantine	Haverhill, Mass.	Diagnostic Roentgenology
786.	Popp, Walter C.	Rochester, Minn.	Therapeutic Radiology
787.	Poppel, Maxwell H.	New York, N. Y.	Diagnostic Roentgenology
788.	Porter, Horace W.	Jackson, Mich.	Radiology
789.	Portmann, U. V.	Cleveland, O.	Radiology
790.	Post, Joseph W.	Philadelphia, Pa.	Diagnostic Roentgenology
791.	Potter, Carlton F.	Syracuse, N. Y.	Roentgenology
792.	Potter, Hollis E.	Chicago, Ill.	Roentgenology
793.	Potter, Roy P.	Marshfield, Wis.	Roentgenology
794.	Pound, Robert E.	New York, N. Y.	Roentgenology
795.	Powell, E. V.	Temple, Tex.	Radiology
796.	Powers, Martin T.	Utica, N. Y.	Diagnostic Roentgenology
797.	Powers, Richard T.	Springfield, Mass.	Radiology
798.	Powers, Robert A.	Palo Alto, Cal.	Radiology
799.	Present, Arthur J.	New York, N. Y.	Radiology
800.	Price, R. J.	Dayton, O.	Radiology
801.	Prouty, J. V.	Terre Haute, Ind.	Radiology
802.	Putts, B. Swayne	Erie, Pa.	Roentgenology
803.	Quick, Douglas	New York, N. Y.	Therapeutic Radiology
804.	Quigley, D. T.	Omaha, Neb.	Radium Therapy
805.	Quimby, A. Judson	New York, N. Y.	Roentgenology
*806.	Quiney, James J.	Easton, Pa.	Radiology
807.	Quinlan, Catherine M.	Santa Rosa, Cal.	Roentgenology
808.	Raap, Gerard	Miami, Fla.	Radiology
809.	Radding, Moses B.	Elizabeth, N. J.	Radiology
810.	Rathbone, Ralph R.	Washington, D. C.	Radiology
811.	Rauschenbach, Charles W.	Hammond, Ind.	Roentgenology
812.	Ravold, Henry J.	St. Joseph, Mo.	Radiology
813.	Ray, William B. G.	Pittsburgh, Pa.	Roentgenology
814.	Reaves, Hugh G.	Knoxville, Tenn.	Roentgenology
815.	Reed, Charles B.	Newburgh, N. Y.	Roentgenology
816.	Rees, Sherman E.	Portland, Ore.	Radiology
817.	Reeves, Robert J.	Durham, N. C.	Radiology
818.	Reiley, William E.	Clearfield, Pa.	Radiology
819.	Reineke, Harold G.	Cincinnati, O.	Roentgenology
820.	Reitter, George S.	East Orange, N. J.	Radiology
821.	Remer, John	New York, N. Y.	Therapeutic Roentgenology
822.	Rendich, Richard A.	Brooklyn, N. Y.	Roentgenology
823.	Reynolds, Gardner S.	Walker, Minn.	Diagnostic Roentgenology
824.	Reynolds, Lawrence	Detroit, Mich.	Radiology
825.	Rhinehart, Darmon A.	Little Rock, Ark.	Roentgenology
826.	Rhudy, Booker, E.	Greensboro, N. C.	Roentgenology

* Deceased.

827.	Rice, Frank M.	San Francisco, Cal.	Roentgenology
828.	Richards, Charles M.	San Jose, Cal.	Radiology
829.	Richman, Samuel	New York, N. Y.	Radiology
830.	Richman, Samuel H.	Chicago, Ill.	Diagnostic Roentgenology
831.	Riebel, Frank A.	Columbus, O.	Radiology
832.	Rigler, Leo G.	Minneapolis, Minn.	Radiology
833.	Ritvo, Max	Boston, Mass.	Radiology
834.	Ritzman, Allen Z.	Harrisburg, Pa.	Roentgenology
835.	Roberts, Douglas J.	Hartford, Conn.	Radiology
836.	Roberts, Joseph E., Jr.	Camden, N. J.	Radiology
837.	Robin, Nathaniel H.	Hempstead, N. Y.	Roentgenology
838.	Robin, Percival A.	Hempstead, N. Y.	Roentgenology
839.	Robins, Samuel A.	Boston, Mass.	Roentgenology
840.	Robinson, G. Allen	New York N. Y.	Therapeutic Radiology
*841.	Robinson, Ralph V.	Pittsburgh, Pa.	Roentgenology
842.	Robinson, Walter W.	Memphis, Tenn.	Roentgenology
843.	Rodenbaugh, F. H.	San Francisco, Cal.	Radiology
844.	Rodgers, Floyd D.	Columbia, S. C.	Radiology
845.	Rodick, J. C.	New Orleans, La.	Roentgenology
846.	Rodriguez, Juan	Fort Wayne, Ind.	Radiology
847.	Roemer, Jacob	Paterson, N. J.	Radiology
*848.	Roland, Marion M.	Oklahoma City, Okla.	Therapeutic Radiology
849.	Rona, Maurice	New Brunswick, N. J.	Roentgenology
850.	Rork, Lee W.	Hastings, Neb.	Roentgenology
851.	Rose, Cassie B.	Boulder, Colo.	Radiology
852.	Rosenbaum, George	Philadelphia, Pa.	Diagnostic Roentgenology
853.	Rosh, Rieva	New York, N. Y.	Therapeutic Radiology
854.	Rothnem, Thomas P.	Fargo, N. D.	Roentgenology
855.	Rousseau, J. P.	Winston Salem, N. C.	Radiology
856.	Rowe, Edward W.	Lincoln, Neb.	Radiology
857.	Rowell, Edward E.	Stamford, Conn.	Roentgenology
858.	Rubenfeld, Sidney	New York, N. Y.	Therapeutic Radiology
859.	Rubert, Samuel R.	Chicago, Ill.	Roentgenology
860.	Rude, Joe C.	New York, N. Y.	Radiology
861.	Rudisill, Hillyer, Jr.	Charleston, S. C.	Radiology
862.	Ruggles, Howard E.	San Francisco, Cal.	Roentgenology
863.	Rulison, Foster C.	Syracuse, N. Y.	Roentgenology
864.	Rutledge, Clifford P.	Shreveport, La.	Radiology
865.	Ryan, Eric J.	New York, N. Y.	Roentgenology
866.	Rypins, Edwin L.	Bloomington, Ill.	Radiology
867.	Samuel, Ernest C.	New Orleans, La.	Roentgenology
868.	Sanderson, Stevens S.	Detroit, Mich.	Radiology
869.	Sante, L. R.	St. Louis, Mo.	Radiology
870.	Sargent, William H.	Oakland, Cal.	Radiology
871.	Schatzki, Richard	Boston, Mass.	Radiology
872.	Schechter, Samuel	New York, N. Y.	Diagnostic Roentgenology
873.	Schenck, Samuel G.	Brooklyn, N. Y.	Radiology
874.	Schimmelpfennig, R. D.	Montclair, N. J.	Roentgenology
875.	Schmidt, Ernst A.	Denver, Colo.	Radiology
876.	Schmitz, Henry	Chicago, Ill.	Therapeutic Radiology
877.	Schmitz, Walter A.	Middletown, N. Y.	Roentgenology
878.	Schnack, A. G.	Honolulu, Hawaii	Radiology
879.	Schnoebelen, Paul C.	St. Louis, Mo.	Roentgenology
880.	Schons, Edward	St. Paul, Minn.	Radiology
881.	Schreiner, Bernard F.	Buffalo, N. Y.	Therapeutic Radiology
882.	Schumacher, F. L.	Pittsburgh, Pa.	Radiology
883.	Schwartz, Charles W.	New York, N. Y.	Roentgenology
884.	Schwartz, Irving	New York, N. Y.	Diagnostic Roentgenology
885.	Scott, Clifton R.	New Haven, Conn.	Roentgenology
886.	Scott, Walter R.	Niagara Falls, N. Y.	Roentgenology
887.	Scott, Wendell G.	St. Louis, Mo.	Radiology
888.	Scott, Wilhelmina S.	Lancaster, Pa.	Radiology
889.	Seeds, Asa E.	Spokane, Wash.	Radiology
890.	Sender, Arthur C.	Philadelphia, Pa.	Roentgenology
891.	Seward, William H.	Orange, N. J.	Radiology
892.	Shapiro, Abraham V.	Brooklyn, N. Y.	Diagnostic Roentgenology
893.	Shapiro, William M.	Toledo, O.	Radiology
894.	Sharpe, A. Maxwell	Chester, Pa.	Roentgenology
895.	Shaw, W. McL.	Jacksonville, Fla.	Roentgenology
896.	Shebesta, Emil M.	Detroit, Mich.	Radiology
897.	Sheldon, Francis B.	Stockton, Cal.	Radiology
898.	Sheridan, William M.	Spartanburg, S. C.	Radiology
*899.	Sherman, Herbert deG.	White Plains, N. Y.	Diagnostic Roentgenology
900.	Sherrick, Earl C.	Connellsville, Pa.	Diagnostic Roentgenology

* Deceased.

901.	Shetter, North W.	Lakewood, O.	Roentgenology
902.	Shiflett, E. Lee	Louisville, Ky.	Roentgenology
903.	Shoemaker, Robert, 3rd	Philadelphia, Pa.	Radiology
904.	Shohan, Joseph	Greensboro, N. C.	Roentgenology
905.	Shore, O. J.	Detroit, Mich.	Diagnostic Roentgenology
906.	Shoulders, H. S.	Nashville, Tenn.	Radiology
907.	Shull, J. Rush	Charlotte, N. C.	Roentgenology
908.	Shulman, Simon	Far Rockaway, N. Y.	Roentgenology
909.	Sichler, Harper G.	Lafayette, Ind.	Radiology
910.	Sickels, Thomas N.	Watertown, N. Y.	Roentgenology
911.	Siefert, Alfred C.	Oakland, Cal.	Radiology
912.	Sigman, Frederick G.	Salisbury, N. C.	Roentgenology
913.	Sims, George P.	Columbus, O.	Therapeutic Radiology
914.	Sinberg, Samuel E.	New York, N. Y.	Diagnostic Roentgenology
915.	Singleton, Arthur C.	Toronto, Ont.	Radiology
916.	Skinner, Edward H.	Kansas City, Mo.	Radiology
917.	Skomp, C. E.	Denver, Colo.	Diagnostic Roentgenology
918.	Smedal, M. I.	Boston, Mass.	Radiology
919.	Smith, Arthur B.	La Jolla, Cal.	Diagnostic Roentgenology
920.	Smith, B. B.	Buffalo, N. Y.	Diagnostic Roentgenology
921.	Smith, Jerome H.	San Angelo, Tex.	Radiology
922.	Smith, Lester A.	Indianapolis, Ind.	Radiology
923.	Smith, Richard L.	Santa Monica, Cal.	Radiology
924.	Smith, R. Manges	Philadelphia, Pa.	Roentgenology
925.	Smith, Roscoe L.	Lincoln, Neb.	Radiology
926.	Smyth, Thomas L.	Allentown, Pa.	Roentgenology
927.	Snead, Lawrence O.	Richmond, Va.	Roentgenology
928.	Snedden, Alexander R.	McKeesport, Pa.	Diagnostic Roentgenology
929.	Snoke, Paul O.	Lancaster, Pa.	Radiology
930.	Snow, Henry	Dayton, O.	Radiology
931.	Snow, William	New York, N. Y.	Roentgenology
932.	Snure, Henry	Los Angeles, Cal.	Roentgenology
933.	Soiland, Albert	Los Angeles, Cal.	Radiology
934.	Solis-Cohen, Leon	Philadelphia, Pa.	Radiology
935.	Sosman, M. C.	Boston, Mass.	Radiology
936.	Soule, Arthur B., Jr.	Burlington, Vt.	Roentgenology
937.	Spackman, Edgar W.	Philadelphia, Pa.	Radiology
938.	Spangler, Davis	Dallas, Tex.	Radiology
939.	Spencer, Hunter B.	Lynchburg, Va.	Roentgenology
940.	Spencer, Jack	Boston, Mass.	Radiology
941.	Spies, John W.	Bombay, India	Therapeutic Radiology
942.	Spillman, Ramsay	New York, N. Y.	Diagnostic Roentgenology
943.	Spilman, Harold A.	Ottumwa, Ia.	Roentgenology
944.	Spinzig, Edgar W.	St. Louis, Mo.	Radiology
945.	Sproull, John	Haverhill, Mass.	Roentgenology
946.	Squire, Fay H.	Chicago, Ill.	Roentgenology
947.	Stafford, Owen R.	Los Angeles, Cal.	Therapeutic Roentgenology
948.	Stall, Arthur H.	Akron, O.	Radiology
949.	Stammel, Charles A.	Fort Benning, Ga.	Diagnostic Roentgenology
950.	Starks, Dorothy J.	Palo Alto, Cal.	Radiology
951.	Startz, Irving S.	Elmhurst, N. Y.	Roentgenology
952.	Stayton, Chester A.	Indianapolis, Ind.	Radiology
953.	Stecher, William R.	Darby, Pa.	Radiology
954.	Steel, David	Cleveland, O.	Roentgenology
955.	Stein, Justin J.	Hines, Ill.	Therapeutic Radiology
956.	Steinberg, Samuel S.	Butte, Mont.	Radiology
957.	Steiner, Joseph M.	New York, N. Y.	Roentgenology
958.	Stenstrom, Annette T.	Minneapolis, Minn.	Diagnostic Roentgenology
959.	Stephenson, F. B.	Denver, Colo.	Radiology
960.	Stevens, R. H.	Detroit, Mich.	Radiology
961.	Stewart, Harry M.	Johnstown, Pa.	Radiology
962.	Stewart, Melba D.	Laconia, N. H.	Roentgenology
963.	Stewart, Ralph C.	Lowell, Mass.	Roentgenology
964.	Stewart, Wendell	East St. Louis, Ill.	Diagnostic Roentgenology
965.	Stewart, William H.	New York, N. Y.	Roentgenology
966.	Stiles, Henry T.	Cleveland, O.	Roentgenology
967.	Stocking, Bruce W.	New York, N. Y.	Radiology
968.	Stone, Robert S.	San Francisco, Cal.	Roentgenology
969.	Stowe, Irving E.	Portsmouth, N. H.	Diagnostic Roentgenology
970.	Strauss, Abraham	Cleveland, O.	Radium Therapy
971.	Strauss, Hyman	Brooklyn, N. Y.	Radium Therapy
972.	Stuart, Leon H.	Tulsa, Okla.	Roentgenology
973.	Sussman, Marcy L.	New York, N. Y.	Radiology
974.	Sutherland, Charles G.	Rochester, Minn.	Diagnostic Roentgenology
975.	Swearingen, Forrest C.	Pomona, Cal.	Radiology

* Deceased.

976.	Swenson, Paul C.	New York, N. Y.	Roentgenology
977.	Swope, Opie W.	Wichita, Kans.	Radiology
978.	Sycamore, Leslie K.	Hanover, N. H.	Radiology
979.	Tabb, John L., Jr.	Richmond, Va.	Roentgenology
980.	Taft, Robert B.	Charleston, S. C.	Radiology
981.	Talley, Daniel D., Jr.	Richmond, Va.	Roentgenology
982.	Tamarkin, Saul J.	Youngstown, O.	Radiology
983.	Taormina, Louis J.	Brooklyn, N. Y.	Diagnostic Roentgenology
984.	Taylor, Clifford C.	Indianapolis, Ind.	Radiology
985.	Taylor, Henry K.	New York, N. Y.	Diagnostic Roentgenology
986.	Taylor, Raymond G.	Los Angeles, Cal.	Radiology
987.	Taylor, Richard T.	Los Angeles, Cal.	Radiology
988.	Teitelbaum, Meyer D.	New Orleans, La.	Roentgenology
989.	Templeton, Frederic E.	Chicago, Ill.	Radiology
990.	Tennis, Matthew N.	Fall River, Mass.	Roentgenology
991.	Thaxter, Langdon T.	Portland, Me.	Roentgenology
992.	Thomas, Camp C.	Lewiston, Me.	Roentgenology
993.	Thomas, M. A.	Cleveland, O.	Radiology
994.	Thompson, Harold B.	Seattle, Wash.	Radiology
995.	Thuresson, Paul F.	Riverside, Cal.	Roentgenology
996.	Tice, Galen M.	Kansas City, Kans.	Radiology
997.	Tichy, L. S.	Chicago, Ill.	Roentgenology
998.	Tidaback, John D.	Summit, N. J.	Roentgenology
999.	Titterington, Paul F.	St. Louis, Mo.	Roentgenology
1000.	Tivnan, Paul E.	Salem, Mass.	Radiology
1001.	Treves, Norman	New York, N. Y.	Therapeutic Radiology
1002.	Troje, Oscar R.	Fairfield, Ala.	Radiology
1003.	Trostler, Isador S.	Chicago, Ill.	Radiology
1004.	Troup, Ralph L.	Green Bay, Wis.	Radiology
1005.	Troxell, William C.	Allentown, Pa.	Roentgenology
1006.	Trueheart, Marion	Sterling, Kans.	Radiology
1007.	Tuggle, Allan	New York, N. Y.	Radiology
1008.	Turnbull, Andrew	Durham N. C.	Radiology
1009.	Tyler, Albert F.	Omaha, Neb.	Radiology
1010.	Ude, Walter H.	Minneapolis, Minn.	Roentgenology
1011.	Ulbrich, Henry L.	Detroit, Mich.	Roentgenology
1012.	Ullmann, Henry J.	Santa Barbara, Cal.	Radiology
1013.	Unfug, George A.	Pueblo, Colo.	Radiology
1014.	Unger, Arthur S.	New York, N. Y.	Roentgenology
1015.	Upson, Wilbur O.	Battle Creek, Mich.	Radiology
1016.	Van Allen, Harvey W.	Springfield, Mass.	Radiology
1017.	Van Atta, J. R.	Albuquerque, N. M.	Radiology
1018.	Van Buskirk, Edmund M.	Fort Wayne, Ind.	Roentgenology
1019.	Van Nuys, Roscoe G.	Berkeley, Cal.	Radiology
1020.	Van Winkle, LeRoy P.	Brooklyn, N. Y.	Diagnostic Roentgenology
1021.	Vance, Robert G.	Boston, Mass.	Roentgenology
1022.	Vastine, Jacob H.	Philadelphia, Pa.	Radiology
1023.	Velkoff, Metodi	Fort Wayne, Ind.	Roentgenology
1024.	Vinnedge, Kenneth H.	Newport, R. I.	Roentgenology
1025.	Virden, C. Edgar	Kansas City, Mo.	Radiology
1026.	Vogt, Edward C.	Boston, Mass.	Roentgenology
1027.	Voke, Edward L.	Akron, O.	Radiology
1028.	Volderauer, John C.	Kalamazoo, Mich.	Radiology
1029.	Voltz, Albert L.	Richmond Hill, N. Y.	Roentgenology
1030.	von Poswick, Gisela	Scranton, Pa.	Roentgenology
1031.	Wachowski, T. J.	Chicago, Ill.	Roentgenology
1032.	Walker, Howard M.	Fort Worth, Tex.	Radiology
1033.	Wallace, K. K.	Norfolk, Va.	Radiology
1034.	Walton, Henry J.	Baltimore, Md.	Radiology
1035.	Wanninger, W. J.	Chicago, Ill.	Diagnostic Roentgenology
1036.	Ward, Charles B.	Seattle, Wash.	Therapeutic Radiology
1037.	Ward, Grant E.	Baltimore, Md.	Radium Therapy
1038.	Warden, Marine R.	Albuquerque, N. M.	Roentgenology
1039.	Warfield, Chester H.	Wichita, Kans.	Roentgenology
1040.	Warren, Alva H.	Malden, Mass.	Diagnostic Roentgenology
1041.	Wasch, Milton G.	Brooklyn, N. Y.	Radiology
1042.	Wasson, W. W.	Denver, Colo.	Radiology
1043.	Waters, Charles A.	Baltimore, Md.	Radiology
1044.	Watkins, W. Warner	Phoenix, Ariz.	Radiology
1045.	Weaver, Clarence E.	Detroit, Mich.	Roentgenology
*1046.	Webb, James A. H.	Wichita, Kans.	Roentgenology

* Deceased.

1047.	Weber, Harry M.	Rochester Minn.	Roentgenology
1048.	Weed, Walter A.	Orlando, Fla.	Radiology
1049.	Weeks, Paul R.	Denver, Colo.	Radiology
1050.	Weinberg, Tobias B.	New York, N. Y.	Roentgenology
1051.	Weirauk, Herbert V.	Columbus, O.	Diagnostic Roentgenology
1052.	Weiskotten, W. Otto	San Diego, Cal.	Roentgenology
1053.	Weitzner, Imre	New York, N. Y.	Radiology
1054.	Weitzner, Samuel F.	New York, N. Y.	Diagnostic Roentgenology
1055.	Wentworth, A. J.	Mankato, Minn.	Radiology
1056.	Wescott, William C.	Atlantic City, N. J.	Radiology
1057.	West, James H.	Cleveland, O.	Radiology
1058.	West, Theodore S.	Port Chester, N. Y.	Roentgenology
1059.	Westing, Siegfried	Brooklyn, N. Y.	Diagnostic Roentgenology
1060.	Wheatley, Frank E.	Boston, Mass.	Radiology
1061.	Wheatley, Louis F.	New Haven, Conn.	Roentgenology
1062.	Wheeler, Digby	Winnipeg, Man.	Roentgenology
1063.	Whelan, Charles	Boston, Mass.	Radiology
1064.	Whitaker, Ben T.	Boone, Ia.	Roentgenology
1065.	White, Clarence M.	Beaumont, Tex.	Diagnostic Roentgenology
1066.	White, Stephen	New York, N. Y.	Diagnostic Roentgenology
1067.	Whitehead, Ely L.	Brooklyn, N. Y.	Radiology
1068.	Whithead, Lawther J.	Richmond, Va.	Roentgenology
1069.	Whitlock, Simon B.	Norfolk, Va.	Roentgenology
1070.	Widmann, B. P.	Philadelphia, Pa.	Radiology
1071.	Wigby, Palmer E.	Dallas, Tex.	Radiology
1072.	Wilcox, Clark A.	Wichita Falls, Tex.	Radiology
1073.	Wilcox, Leslie F.	Detroit, Mich.	Radiology
1074.	Williams, Albert E.	Hines, Ill.	Therapeutic Radiology
1075.	Williams, Arthur J.	San Francisco, Cal.	Radiology
*1076.	Williams, Francis H.	Boston, Mass.	Radiology
1077.	Williams, Lester J.	Baton Rouge, La.	Radiology
1078.	Williams, P. A.	Hempstead, N. Y.	Roentgenology
1079.	Willy, Ralph G.	Chicago, Ill.	Roentgenology
1080.	Winchell, A. Vaughn	Philadelphia, Pa.	Therapeutic Radiology
1081.	Wilson, Hugh M.	New Haven, Conn.	Roentgenology
1082.	Wilson, James E.	Clarksburg, W. Va.	Diagnostic Roentgenology
1083.	Wilson, John S.	Monticello, Ark.	Therapeutic Radiology
1084.	Wilson, R. T.	Austin, Tex.	Roentgenology
1085.	Wilson, Stanley A.	Salem, Mass.	Roentgenology
1086.	Wirth, John E.	Seattle, Wash.	Therapeutic Radiology
1087.	Wissler, J. E.	Washington, D. C.	Radiology
1088.	Withers, Sanford M.	Denver, Colo.	Therapeutic Radiology
1089.	Witwer, E. R.	Detroit, Mich.	Radiology
1090.	Woodruff, Marston T.	Philadelphia, Pa.	Roentgenology
1091.	Woolford, Joseph S.	Eureka, Cal.	Radiology
1092.	Woolley, Ivan M.	Portland, Ore.	Roentgenology
1093.	Wright, Cecil S.	Indianapolis, Ind.	Radiology
1094.	Wright, Harold E.	Baltimore, Md.	Roentgenology
1095.	Wurster, Lloyd E.	Williamsport, Pa.	Roentgenology
1096.	Wyatt, George M.	Cleveland, O.	Roentgenology
1097.	Young, Barton R.	Philadelphia, Pa.	Radiology
1098.	Young, James L. R.	New York, N. Y.	Therapeutic Radiology
1099.	Zeitlin, Nathan S.	Chicago, Ill.	Roentgenology
1100.	Ziliak, A. Lawrence	Bay City, Mich.	Roentgenology
1101.	Zimmerman, Carl A. W.	Cape Girardeau, Mo.	Diagnostic Roentgenology
1102.	Zink, Oscar C.	St. Louis, Mo.	Radiology
1103.	Zulick, J. Donald	Philadelphia, Pa.	Roentgenology

* Deceased.

The Board will hold two examinations during 1938, the first at the Mark Hopkins Hotel in San Francisco, June 10–12, and the second at the time and place of the meeting of one of the two national radiologic societies, depending on which society meets at the more convenient place. Those wishing to appear for examination in San Francisco should have their applications on file by March 1.

For information, communicate with the Secretary, 102–110 Second Avenue, S.W., Rochester, Minnesota.

B. R. Kirklin, M.D.
Secretary-Treasurer

EXAMINATION FOR ENTRANCE INTO THE MEDICAL CORPS OF THE NAVY

An examination of candidates for appointment as Lieutenant (junior grade), in the Medical Corps of the Navy, will be held at all Naval Hospitals in the United States and at the Naval Medical School, Washington, D. C., beginning May 16, 1938.

Candidates for admission must be between the ages of 21 and 32 years at time of appointment, graduates of a Class "A" medical school, and have completed an internship of one year in a hospital accredited for interns by the American Medical Association and the American College of Surgeons.

Those who are interested should write the Surgeon General, U. S. Navy, Bureau of Medicine and Surgery, Navy Department, Washington, D. C., for further information in regard to the examination and the procedure to follow for them to appear before one of the Examining Boards.

BOOKS RECEIVED

Books received are acknowledged under this heading, and such notice may be regarded as an acknowledgment of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

DAS VENTRICULOGRAMM (The Ventriculogram). Acta Radiologica, Supplementum XXV. By ERIK LYSHOLM, Dozent fur Medizin, Radiologie; BERTIL EBENIUS, und HANS SAHLSTEDT, Assistenten am Röntgeninstitut. II.—Teil, Die Seitenventrikel. A volume of 199 pages, with 284 illustrations. Published by P. A. Norstedt & Sons, Stockholm, Sweden, 1937. Price: 15 Kronen.

THE PRACTICE OF IONIZATION. By J. NEWTON DYSON, M.R.C.S. (Eng.), L.R.C.P. (Lond.), with a Foreword by ELKIN P. CUMBERBATCH, M.A., B.M., (Oxon.), D.R.M.E. (Camb.), F.R.C.P. A volume of 178 pages, with 9 illustrations. Published by Henry Kimpton, London, England, 1936. Price: $1.50.

SYNOPSIS OF DIGESTIVE DISEASES. By JOHN L. KANTOR, Ph.D., M.D., Associate in Medicine, Columbia University; Gastroenterologist and Associate Roentgenologist, Montefiore Hospital for Chronic Diseases, New York. A volume of 302 pages, with 40 illustrations. Published by C. V. Mosby Co., St. Louis, Mo., 1937. Price: $3.50.

THE ROENTGENOLOGIST IN COURT. By SAMUEL WRIGHT DONALDSON, A.B., M.D., F.A.C.R., St. Joseph's Mercy Hospital, Ann Arbor, Michigan. A volume of 230 pages. Published by Charles C. Thomas, Springfield, Ill., 1937. Price: $4.00.

SOME QUANTITATIVE ASPECTS OF THE BIOLOGICAL ACTION OF X- AND GAMMA RAYS. By C. M. SCOTT, M.D. Special Report Series No. 223. A volume of 99 pages, with 21 illustrations. Medical Research Council.

RADIATION THERAPY: ITS USE IN THE TREATMENT OF BENIGN AND MALIGNANT CONDITIONS. By IRA I. KAPLAN, B.Sc., M.D., Clinical Professor of Surgery, New York University Medical College; Director, Radiation Therapy Department, Bellevue Hospital, New York; Director, Division of Cancer, Department Hospitals, City of New York; Director, New York City Cancer Institute; Associate Radiologist, Lenox Hill Hospital, New York: Editor (Therapeutic Section) "Year Book of Radiology." A volume of 558 pages, with 198 illustrations. Published by Oxford University Press, New York City. Price: $10.00.

THE 1937 YEAR BOOK OF RADIOLOGY. Radiologic Diagnosis. Edited by CHARLES A. WATERS, M.D., Associate in Roentgenology, Johns Hopkins University; Asst. Visiting Roentgenologist, Johns Hopkins Hospital: Associate Editor, WHITMER B. FIROR, M.D., Asst. in Roentgenology, Johns Hopkins University. Therapeutics, Edited by IRA I. KAPLAN, B.Sc., M.D., Director, Division of Cancer, Dept. of Hospitals, City of New York, Clinical Professor of Surgery, New York University Medical College, Director Radiation Therapy Dept., Bellevue Hospital, New York City; Director, New York City and Brooklyn Cancer Institutes; Associate Radiologist, Lenox Hill Hospital, New York City. A volume of 503 pages, with 550 illustrations. Published by The Year Book Publishers, Inc., Chicago, Ill., 1937. Price: $4.50.

PRINCIPLES OF ROENTGENOLOGICAL INTERPRETATION. By L. R. SANTE, M.D., Professor of Radiology, St. Louis University School of Medicine; Radiologist to St. Louis City Hospital and St. Mary's Hospital, St. Louis. A volume of 340 pages, with 330 illustrations. Published by Edwards Brothers, Inc., Ann Arbor, Michigan, 1937. Price: $5.50.

THE COLLAPSE THERAPY OF PULMONARY TUBERCULOSIS. By JOHN ALEXANDER, M.D., F.A.C.S., Professor of Surgery, University of Michigan; Surgeon-in-Charge, Division of Thoracic Surgery, Department of Surgery, University of Michigan Hospital. A volume of 705 pages, with 367 illustrations. Published by Charles C. Thomas, Springfield, Ill., 1937. Price: $15.00.

BOOK REVIEWS

CARCINOMA OF THE FEMALE GENITAL ORGANS. By M. C. MALINOWSKY and E. QUATER. A volume of 255 pages, with 50 illustrations. Published by Bruce Humphries, Inc., Boston, Mass., 1936. Price: $5.00.

This volume, translated from the Russian by A. S. Schwartzmann, while not exhaustive, contains a sufficiently thorough discussion of the problem of carcinoma of the female sexual sphere. Beginning with a chapter on the pathogenesis and etiology of tumors, the writers discuss all phases of the problem including pathology, clinical appearance, and treatment, and wind up with a brief word on carcinoma of the breast. The material is ably arranged and presents what is probably a consensus of the opinions of most writers on this subject.

The chapters on treatment are particularly good, giving an unbiased view of the places held by surgery and radiant energy. Methods of combining radium and x-ray are described and evaluated, and statistics are extensively quoted. The book is amply illustrated.

GRUNDZÜGE DER RÖNTGENPHYSIK (Fundamentals of Roentgen Physics). Eine Einfuhrung in die Gesetze der Röntgenstrahlen zur Verwendung in Physik, Kristallographie, Medizin, und Technik. By Dr. PHIL. FRITZ REGLER. A volume of 467 pages, with 339 illustrations. Published by Urban & Schwarzenberg, Berlin, Germany, 1937. Price: RM 21.

The author, who is an assistant professor in the "Technische Hochschule" in Vienna, has prepared this book to familiarize the reader with the fundamental laws governing roentgen rays as they apply to physics, crystal analysis, medicine, and industry.

Following a brief introduction regarding the production and wave length of roentgen rays their nature is explained in detail. Ample space is devoted to the discussion of the x-ray spectrum, the absorption and ionization by roentgen rays, their photochemical and biological effects. Under the heading "Ionization" the reader finds data on the international "r" and methods of determining the output of x-ray apparatus. The Geiger counter is briefly described. Brief but practical data on protection against radiation are also supplied. Those interested in radiographic technic will welcome the chapter dealing with the theoretical principles involved in producing and evaluating the roentgenogram. This includes the principles of stereoscopy, cinematography, and testing of screens. The theories of roentgen spectroscopy and crystal analysis by means of roentgen rays are clearly related and the methods of Laue, Debye-Scherrer as well as the rotating crystal method have been included.

The relation between tube potential and half value layer, the determination of the depth dose percentage and methods for measuring high voltage are also outlined. A discussion of diffraction of electrons on crystals, scattering of roentgen rays and electrons in liquids and gases, and a description of roentgen apparatus and tubes conclude the text. An appendix contains some tables with useful data on the wave length of characteristic radiation and lattice constants.

Because the book is meant for a large group of readers the author has attempted not to give preference to the interests of one single science. This accounts for the fact that the medical reader would like, perhaps, additional data and more detail in those chapters which are of specific interest to him. However, the book contains a wealth of material, and because difficult mathematical formulæ have been omitted, without subtracting from the accuracy of the presentation, it is recommended as a good introduction into the fundamentals of x-ray physics.

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S. RICHARD BEATTY, M.D., of Madison, Wis.
J. E. HABBE, M.D., of Milwaukee, Wis.
HANS W. HEFKE, M.D., of Milwaukee, Wis.
L. G. JACOBS, M.D., of Madison, Wis.
E. T. LEDDY, M.D., of Rochester, Minn.
ERNST A. POHLE, M.D., Ph.D., of Madison, Wis.
CHARLES G. SUTHERLAND, M.B. (Tor.), of Rochester, Minn.

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HEART AND VASCULAR SYSTEM

A Roentgenological Study of the Heart Size in Athletes. Hugo Roesler. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36,** 849–853.

The author discusses the differing opinions of various investigators as to the influence of strenuous athletics requiring prolonged exertion on heart size and heart muscle hypertrophy. Serial or single orthodiagraphic studies on four individuals all giving a history of some years of athletic activities, lead to the belief that as a result of such physical activities there may develop a slight but significant enlargement, to be followed by measurable decrease in heart size shortly after such exertions are discontinued.

J. E. HABBE, M.D.

Directed Roentgenography of the Thorax (The Cardiocairograph). I. Seth Hirsch and Myron Schwarzschild. Am. Jour. Roentgenol. and Rad. Ther., January, 1937, **37,** 13–20.

This refers to an exposure of the chest at a predetermined phase of the cardiac cycle, and is accomplished by the synchronization of the exposure with a selected phase of the circulatory phenomenon, namely, the action current impulse. The desirable instant is the end-phase of diastole, and by the use of an apparatus which is very thoroughly described the exposure is made by the R wave of the electrocardiogram, and thus without the use of any time delay. If it is desired to make the exposure at systole, it can be simply arranged so. Thus the heart in systole and diastole can be compared, and films at a later date taken in the same phase for comparison. This method has proven that an exposure lasting through several cardiac cycles does not show the heart in maximum diastole. Kymographic studies can also be timed for correct phase by the same apparatus.

This apparatus, by means of which for the first time the exposure can be made at a predetermined phase of the cardiac cycle, was invented and constructed by the authors.

S. M. ATKINS, M.D.

Dissecting Aneurysm of the Aorta. T. E. McGeachy and J. E. Paullin. Jour. Am. Med. Assn., May 15, 1937, **108,** 1690–1698.

Of almost 500 cases dealing with rupture of the aorta reported in the literature, in only nine has a correct antemortem diagnosis been made. Dissecting aneurysm of the aorta is an incomplete rupture of the aortic wall wherein the escaping fluid separates the layers of the arterial wall to a variable extent. There is usually a terminal rupture at some distant point, either externally or into the original blood channel. Rarely, spontaneous fibrosis and healing occur without a second rupture. It is most common between the ages of 40 and 70 years. Males are affected twice as frequently as females. It is found approximately once in 500 autopsies. There are two main causative factors: a defective aortic wall, usually a degenerative change in the media as a result of sclerosis of the vasa vasorum, and an abnormal hydrostatic pressure in the aorta.

The onset is sudden, during exertion, with agonizing, tearing pain, usually in the anterior portion of the chest, which is so severe that shock immediately follows. The pain more often radiates to the back in either the thoracic or the lumbar region.

The roentgenographic features are: a deformity of the supercardiac shadow, which may or may not pulsate under the fluoroscope; an arcuate excrescence arising from any portion of the thoracic aorta, at times a shadow may be seen along an aortic branch, and this is the most pathognomonic of all x-ray appearances. There is at times displacement of the trachea and esophagus, and at times a non-fatal leakage may be evident as a pleural effusion, usually left-sided or as a mediastinal infiltration. Cardiac hypertrophy is nearly always present.

CHARLES G. SUTHERLAND, M.B. (Tor.).

HODGKIN'S DISEASE

Hodgkin's Disease and Allied Conditions of Bone. Richard Dresser and Jack Spencer. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36,** 809–815.

In a recent five-year period, 149 cases of Hodgkin's disease were examined with particular attention to the osseous system for evidence of bone lesions. There were 16 cases showing bone changes; an incidence, therefore, of 10.7 per cent. Subsequent to this series there were 46 more cases found with bone changes in Hodgkin's disease. The pathologist classified most of the bony lesions as belonging to the Hodgkin's group, a small percentage as reticulum cell sarcoma, and a very few as lymphosarcoma. The majority of the cases were in the third or fourth decades of life.

The bones most commonly involved were: spine (usually lumbar), 24 per cent; pelvis, 19 per cent; ribs, 9 per cent; sternum, 7.5 per cent. The x-ray appearance simulates metastatic malignancy, or (less often) Ewing's tumor, osteogenic sarcoma, or bone cyst. The picture is *not* characteristic.

The bone involvement was an early one in 25 per cent of the cases wherein it was found. However, a primary involvement of the bones without involvement of lymph nodes, spleen, or liver was not found, the bone involvement being either metastatic *via* the blood stream or by direct extension from diseased glands.

While relief of pain by roentgen therapy is often striking, the x-ray appearance of the lesions after treatment is often stationary. High voltage and daily doses of from 200 to 300 r are recommended.

J. E. HABBE, M.D.

HYPERPARATHYROIDISM

Bio-assay of a Parathyroid Adenoma in a Case of Generalized Osteitis Fibrosa. Sylvan E. Moolten, Francis M. Clarke, and Henry Haywood. Jour. Am. Med. Assn., Jan. 9, 1937, **108,** 111, 112.

This is a report of a typical case of hyperparathyroidism in which surgical excision of an adenoma of the left lower parathyroid gland resulted in marked clinical improvement.

Bio-assay of the gland revealed approximately 105 units of hormone per gram.

Search of the literature revealed no previous instance in which direct analysis was made of the hormone content of such an adenoma.

CHARLES G. SUTHERLAND, M.B. (Tor.).

THE KIDNEY

Small Calculus in the Kidney Pelvis Localized by the Intravenous Injection of a Small Quantity of Ténèbryl. H. Béclère. Bull. et Mém. Soc. Radiol. Méd. de France, January, 1937, **25,** 11, 12.

A small opaque calculus in the region of the right kidney was definitely localized by the injection of 20 c.c. of 30 per cent Ténèbryl, which gave a shadow of relatively little density. After 15 minutes the stone was hidden by the dye, but after 35 minutes, lessened concentration of the dye permitted its visualization in the lower pole of the pelvis.

S. RICHARD BEATTY, M.D.

Echinococcus Cyst of the Kidney. Joseph Tenenbaum. Jour. Am. Med. Assn., May 15, 1937, **108,** 1704, 1705.

Hydatid disease involving the kidney is rare in this country. Approximately thirty cases have been reported in the American literature. Hydatid disease represents the larval or cystic stage of the *Taenia echinococcus,* which in the mature stage is found in the small intestine of the dog, wolf, cat, and other carnivora. In common with cattle, sheep, horses, and other herbivora, man shares the function of intermediary host through ingestion of parasitic ova passed on with the feces from an infested primary host (commonly the dog). The larva liberated in the process of digestion is carried through the portal venous system to the liver (the most common location of hydatid cyst), thence less commonly to the lungs and, if not arrested before it reaches the left ventricle, it may be swept through the circulation into any other part of the body, including the cortex of the kidney. Echinococcus cyst in the kidney is found in about 2 per cent of the cases of hydatid disease.

It takes approximately fifteen to twenty years for the development of a full-sized echinococcus cyst, and as long as there is no communication with the pelvis (closed cyst) there are no early symptoms except such as may be caused later through pressure, displacement, and destruction of the kidney substance associated with hydronephrosis. In time, especially in the presence of infection, the tissues of the hydronephrotic pelvis adjacent to the sac may yield to pressure, establishing free communication for spontaneous evacuation of the cystic contents (spontaneous cure). More often, after spilling some of its contents, the communicating rent may become sealed and the sac refilled with daughter cysts (fractional evacuation). This process may be repeated from time to time, accompanied by renal colic due to passage of the daughter cysts through the ureters, and occasionally hematuria. There are two other eventualities of cyst involution: one caused by the slow leakage and absorption of the echinococcus fluid, with consecutive degeneration and calcification of the cyst (a process similar to autonephrectomy in renal tuberculosis), or the cyst may rupture externally, spilling its contents into the perirenal space and peritoneal sac (hydatid peritonitis). There is also danger of metastatic secondary echinococcosis due to a rupture of a fertile simple cyst into the heart or venous system.

Plain roentgenograms of the genito-urinary tract may or may not show the presence of a large mass in the kidney region; pyelography rarely fails to demonstrate some degree of hydronephrosis, compression or displacement, irregularity or a moth-eaten appearance of one or more calices, and in the colicky type some degree of dilatation of the ureter.

CHARLES G. SUTHERLAND, M.B. (Tor.).

THE KNEE JOINT

Primary Hematogenous Osteitis of the Patella. F. L. Flack. Jour. Am. Med. Assn., June 26, 1937, **108,** 2199.

Primary spontaneous hematogenous osteitis of the patella, according to the reported cases, is rare. The diagnosis of this condition is not often made early enough to prevent marked destruction of the patella and extension of the lesion. Records of about 40 cases were found in the literature.

The author reported a case in a female, aged 20, with a history of gradually increasing pain over a period of eight weeks. There was no history of trauma or local infection. X-ray examination showed marked absorption and osteitis of the patella, with multiple sequestra. An incision was made over the patella, and a large pocket of pus was evacuated. Microscopic examination and cultures showed *Staphylococcus aureus.* While no history was obtainable, a metastatic infection from the throat was suspected as the etiologic factor.

CHARLES G. SUTHERLAND, M.B. (Tor.).

THE LUNGS

Cancer of the Lung in the Hospitals of Brussels. M. Heriant. Bruxelles Médical, March 28, 1937, 800–819.

It is the belief of the author that the actual incidence of pulmonary cancer is increasing. In one of Brussels, two larger hospitals, in 1924, the percentage of pulmonary cancers found was 2.2 per cent of all cancers. In 1935, 14.5 per cent of all cancers were pulmonary.

In another hospital, of 446 cancer autopsies, pulmonary cancer was present in 6 per cent, in 1924, but in the year 1935 the incidence was 13 per cent.

Of a total of 103 cases of pulmonary carcinoma, 84 were men, 19 were women. The major incidence occurred in the sixth decade, the youngest victim in this series being 28, the oldest 77.

The etiologic factors are discussed in some detail; no specific cause can be determined.

The author discusses the pathologic anatomy of pulmonary tumors, their metastases and the secondary pathology at length. The article is to be continued in another issue.

S. RICHARD BEATTY, M.D.

Thrombosis of the Pulmonary Artery. G. Liebmeister. München. med. Wchnschr., July 16, 1937, **84,** 1131, 1132.

This is a case report of a patient with thrombosis of the pulmonary artery and other cardiac disease. The author thinks the diagnosis can be made clinically on the basis of a cyanosis, which has not been present since childhood, of disproportion between the deep cyanosis and the slight dyspnea, and of the finding of greatly increased and sharply marked out vascular shadows in the roentgenograms of the pulmonary hilus.

L. G. JACOBS, M.D.

The Roentgenologic Appearance of Bulbous Emphysema in Subjects with Cervical Ribs. Filoreto d'Agostino. Archivio di Radiologia, 1936, **12,** Nos. 3–4, 185–189.

This is a case report of a patient followed, for three years, who had bulbous emphysema in the left apex. The author illustrates the lesion by serial roentgenograms, to show a relationship between it and cervical ribs.

E. T. LEDDY, M.D.

Recurrent Idiopathic Spontaneous Pneumothorax. Leslie K. Sycamore. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36,** 844–848.

A case is reported of a male, 30 years of age, who, within a period of three years, suffered five attacks of spontaneous pneumothorax involving the right chest. The causative factor, an emphysematous bleb, was demonstrable at several of the roentgen examinations. After the fourth recurrence it was thought advisable to excise the bleb. This was done, the microscopic appearances indicating emphysematous bleb rather than congenital cyst. The patient has since remained free of recurrence.

J. E. HABBE, M.D.

Changes in Tumors of the Bronchus Following Radiation Therapy as Demonstrated in the Bronchogram. A. Beutel and F. Strand. Strahlentherapie, 1937, **59,** 497.

The authors studied the changes in the chest roentgenogram with and without lipiodol injection in patients who had been treated for carcinoma of the bronchus by roentgen rays. The response to the treatment manifested itself in the chest film in a slow disappearance of the density produced by the tumor, followed by a shrinking process corresponding to an induration. Following injection of lipiodol the filling defects seen in the bronchus preceding the treatment become smaller, the irregular edges appear more smooth, and some of the obstructed bronchi become patent. If metastatic lymph glands are present and are reduced under radiation therapy, the encroachment on the bronchi disappears and normal contours are restored. The induration of the lung following shrinkage of the tumor may cause obliteration of some of the bronchi and lead later to the development of bronchiectasis.

ERNST A. POHLE, M.D., Ph.D.

Cancer of the Lung. Editorial. Jour. Am. Med. Assn., May 15, 1937, **108,** 1716, 1717.

The incidence of cancer of the lung, as cited in recent statistical reports, varies between 5 and 10 per cent of all cancers. Among the contributing factors to this unmistakably steady increase, the injurious effects of tobacco smoking, exhaust gases from automobiles, tar on roads, and the influenza epidemic of 1918–1919 have been suggested. None of these can be accepted as definitely causative. The disease is preponderantly more common in males than in females; about two-thirds of all cases occur between the ages of 40 and 60. A persistent cough, hemoptysis, and thoracic pain of a severe and continuous type in a man past the age of 40 are highly suggestive of cancer. The earliest manifestations may be those of metastasis away from the thoracic cage. Bronchopulmonary cancer displays a tendency to give rise to metastases to the liver, bones, spleen, pancreas and, with a characteristic frequency, to the suprarenals and the brain. X-ray examination of the chest alone is capable of rendering a correct diagnosis of carcinoma in not less than two-thirds of all cases. Bronchoscopic examination in the hands of an expert is valuable not only because it can visualize the tumor within the main bronchus but even more so because of the possibility of obtaining a biopsy specimen. The future of therapy rests largely on the success of lobectomies and occasional pneumonectomies.

CHARLES G. SUTHERLAND, M.B. (Tor.).

PEPTIC ULCER

Perforations (Stomach, Urinary Bladder, Kidney). R. Janker. Röntgenpraxis, November, 1936, **8,** 51.

Perforation of ulcers during or shortly after roentgen examination has been reported about fifty times in the literature. Because of the comparative rarity of this occurrence a case of perforation of a gastric ulcer during roentgen examination is described. The barium was seen outside the stomach on the second film, and free air was noted under the diaphragm. Because compres-

sion and deep palpation were not used, the author believes that filling of the stomach with a rather large amount of barium was probably the cause for this accident. The patient died.

A case of perforation of the bladder probably caused by a very difficult cystoscopic examination with contrast material outside the bladder on the cystogram shows the danger of injection of such substances after a difficult cystoscopy. The outcome was fatal.

Injury to the kidneys by ureter catheters is not a rare occurrence. In the author's case the catheter apparently perforated a calyx and kidney substance. The skiodan was seen between the kidney proper and its capsule. There was no untoward reaction from this accident.

HANS W. HEFKE, M.D.

PITRESSIN

Use of Pitressin. A. Jutras and A. Cantero. Jour. de Radiol. et d'Electrol., August, 1936, **20,** 443–445. (Reprinted by permission from British Med. Jour., Dec. 12, 1936, p. 98 of Epitome of Current Medical Literature.)

The authors advise the use of pitressin, which is a non-oxytocic extract of the anterior lobe of the pituitary, in all cases of abdominal radiography in which the presence of gases may prove disturbing. Pitressin causes contraction of the smooth muscular fibers and thus helps to expel the intestinal gases. Pitressin is contra-indicated in cases of intestinal obstruction and in cases suffering from cardiac, vascular, or renal disease in view of the temporary increase of the blood pressure it usually produces. The medicament is given in doses of 1 c.c. intramuscularly. The authors usually give a saline enema before cholecystography and a plain water enema in intestinal radiography (for examination of the relief of the mucous membrane) prior to injection of pitressin. The radiographs are taken from one to three hours after the injection.

THE PROSTATE

Effect of Roentgen Therapy on Hypertrophy of the Prostate. G. H. Schneider. Strahlentherapie, 1937, **59,** 346.

The author relates his experience with roentgen therapy in non-malignant hypertrophy of the prostate. He uses five fields of 10 × 15 cm. size and administers from 360 to 500 r per area in order to have 90 per cent of a skin erythema dose effective in the gland. A caliper is shown which permits the exact determination of the distance between skin surface and prostate. An analysis of 24 cases treated by him showed encouraging results.

ERNST A. POHLE, M.D., Ph.D.

The Treatment of Prostatic Carcinoma. Benjamin S. Barringer. Am. Jour. Roentgenol. and Rad. Ther., January, 1937, **37,** 49–52.

The most common origin of carcinoma is in the posterior lobe, especially when the lesion is large enough for diagnosis, and here aspiration biopsy will be dependable in 80 per cent of the cases. Cystoscopy with examination of section of the bladder neck can also be done. Surgical removal is difficult and the results not very satisfactory, and thus interstitial radon needles and external radiation combined offer a better outlook.

S. M. ATKINS, M.D.

RADIATION INJURIES

Roentgen Injuries Following Therapeutic Irradiation. J. Körbler. Strahlentherapie, 1937, **59,** 146.

The author reports six cases of late roentgen injuries and discusses the precautions which should be observed in their prevention. Even so-called safe doses may lead to late reactions, especially if some secondary agent (ultra-violet light, medication, or chronic irritation) affects the irradiated skin.

ERNST A. POHLE, M.D., Ph.D.

Findings in the Death of a Radiologist. M. Roques. Bull. et Mém. Soc. Radiol. Méd. de France, January, 1937, **25,** 95–98.

The clinical, laboratory, and postmortem findings in the case of a radiological technician who was exposed to considerable roentgen radiation for ten years are given. The symptoms and clinical findings lead to a diagnosis of appendicitis, and laparotomy was performed. A trace of albumin was found in the urine. The blood studies showed 3,900,000 red cells, 19,700 white cells, polymorphonuclear leukocytes 87 per cent, small mononuclears 4 per cent, large mononuclears, 5 per cent, and lymphocytes 4 per cent. The peritoneal contents were normal at operation. The patient post-operatively suffered crises of abdominal pain and died in a week.

At postmortem the chief findings included a hazelnut-sized hemorrhage in the left frontal region, sanguineous peritoneal fluid with hemorrhage in the left subdiaphragmatic region centering in the pancreas, a small spleen with several miliary infarcts, recent infarct in the right kidney.

The author believes death primarily was caused by hemorrhage in association with a toxic anemia due to x-ray. He discusses the effects of irradiation on the blood-forming elements.

S. RICHARD BEATTY, M.D.

A Severe Roentgen "Combination" Injury. V. Wucherpfennig. Strahlentherapie, 1937, **58,** 155.

The author relates the history of two boys who were epilated in August, 1928, because of favus. As treatment, 475 r were applied over five fields with 84 kv., no filter, at 25 cm. F.S.D. Three weeks after the treatment both patients showed a roentgen reaction of the third or fourth degree over the scalp. Skin changes visible in the upper cheeks, eyelids, and conjuctiva were

suspicious of a chemical reaction and appeared to be due to the application of chrysarobin applied since the treatment. The lesions in one patient healed eventually with complete epilation after four months, while the other required treatment over a two-year period. The court exonerated the clinic on the basis of the explanation of a combined injury.

ERNST A. POHLE, M.D., Ph.D.

RADIUM

Prolonged Results in Some Cases Treated with Radium. M. T. Nogier. Bull. et Mém. Soc. Radiol. Méd. de France, January, 1937, **25,** 87–91.

The author presents three cases of cancer of the cervix alive and well fourteen years, seven years six months, and five years two months, respectively, following radium therapy; two cases of cancer of the tongue free of disease for six years six months, and three years five months, respectively, and a case of sublingual epithelioma now well for five years three months. The case histories and technic of employment of radium are given.

S. RICHARD BEATTY, M.D.

The Application of "Weak Radium Therapy" in Dermatology. S. R. Brünauer. Strahlentherapie, 1937, **58,** 83.

The term "weak radium therapy" comprises, according to the author, the use of radium emanation taken in water *per os*, in bath or inhalations and also applications of radio-active ointments. He describes a 9×12 sq. cm. flexible radium applicator containing 1 mg. radium bromide. It is so constructed as to permit the use of alpha, beta, and gamma rays. It may be applied for 12 hours in one sitting from three to six times, followed by an interval of from 10 to 14 days. The treatment seemed to be effective in eczema, psoriasis, lichen ruber planus, and papillomatosis of the skin in the face. The radon ointment was of benefit in pruritus, hyperkeratosis, and eczema between the toes.

ERNST A. POHLE, M.D., Ph.D.

Results of Treatment with Small Doses of Radium Emanation. E. Uhlmann. Strahlentherapie, 1937, **58,** 664.

The author has seen good results in the treatment of roentgen ulcers by roentgen emanation; he has had opportunity to observe 60 cases during the last seven years. Radium ointment is used which contains from 50 to 100 E.S.E. per gram of vaseline. A dressing is applied and the emanation left, usually for eight hours. The treatment may be repeated at intervals of seven days. In patients whose skin is sensitive to ointments it is advisable to use moist dressings, preferably 2 per cent boric acid solution. Photographs of a roentgen ulcer, before and after treatment, in a patient with diabetes, are shown in the article.

ERNST A. POHLE, M.D., Ph.D.

THE SPINE

Spondylolisthesis with Regional Disturbance of Calcium Metabolism. H. Tillier and Bréchet. Bull. et Mém. Soc. Radiol. Méd. de France, February, 1937, **25,** 138–141.

In conjunction with an old traumatic spondylolisthesis with marked variation in the amount of calcium in the vertebræ and calicification in the ilio-lumbar and other ligaments, films of the abdomen demonstrated a calcified plaque at the site of an appendectomy scar in one of the authors' cases. They hypothesize a regional disturbance in calcium metabolism subsequent to the injury.

S. RICHARD BEATTY, M.D.

Vertebral Epiphysitis and Pott's Disease. M. Chassard. Bull. et Mém. Soc. Radiol. Méd. de France, January, 1937, **25,** 81–83.

Vertebral epiphysitis in adolescents is rather frequent but is not always recognized in the less severe cases. The involvement of multiple vertebræ and the conservation of the intervertebral disks usually makes confusion with Pott's disease unlikely. Occasionally, however, the vertebral bodies show irregularities, deformities, or actual loss of substance which simulate tuberculous lesions and rarely is there localized narrowing of the intervertebral space. The absence of the fusiform abscess shadow, the practically constant involvement of multiple vertebræ, and the tendency to rapid recalcification and hyper-calcification will serve to distinguish these lesions from those of Pott's disease.

S. RICHARD BEATTY, M.D.

Symptomatology and Therapy of Metastatic Carcinoma in the Spine. O. Deutschberger. Strahlentherapie, 1937, **58,** 684.

The author recommends 2,000 r effective in the affected vertebra and applied during a period of from three to four weeks in the treatment of metastatic carcinoma of the spine. Relief from pain is seen in the majority of cases, and in a small percentage recalcification occurs after a period of from three to four months. While some lesions may remain healed for a year and one-half, recurrences usually do occur.

ERNST A. POHLE, M.D., Ph.D.

Multiple Tumors within the Spinal Canal. John D. Camp. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36,** 775–781.

For completely obstructing lesions of the spinal canal the use of 2 c.c. of lipiodol, as originally recommended by Forestier in 1922, may be sufficient, but when there are multiple tumors which only partially obstruct the canal space the author has found it necessary to inject 5 c.c. of the opaque oil, and thereafter to observe the movements of the oil on a tilting roentgenoscopic table

with the patient in supine, prone, oblique, and lateral positions. While the large majority of spinal cord tumors are single, in a recent series of 72 cases 4 per cent were identified as multiple by the writer, using the above-described technic. Five cases of multiple cord tumors, with or without co-existing prolapse of the intervertebral disks, are reported.

J. E. HABBE, M.D.

The Azygos Lobe and Congenital Costo-vertebral Malformations. M. J. Jalet. Bull. et Mém. Soc. Radiol. Méd. de France, February, 1937, **25**, 141–143.

The author calls attention to the frequency with which abnormalities of the cervical spine accompany the presence of an azygos lobe. These abnormalities include cervico-dorsal scoliosis, hypertrophy of the transverse processes of the seventh cervical vertebra, cervical ribs, spina bifida occulta, hemivertebra, and other anomalies of maldevelopment or fusion of the cervical vertebræ.

S. RICHARD BEATTY, M.D.

The Roentgenographic Demonstration of Rupture of the Intervertebral Disk into the Spinal Canal after the Injection of Lipiodol. Aubrey O. Hampton and J. Maurice Robinson. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36**, 782–803.

The authors report the technic of examination and the findings in cases of unilateral or bilateral rupture of the intervertebral disks with protrusion of the posterior portion of the disk into the spinal canal space. These cases clinically did not have symptoms of cord tumor but were clinically classified as "low back strain," "sciatica," or "sacro-iliac disease" cases. The accuracy of the method is indicated by the fact that 30 out of 31 cases of intervertebral disk ruptures operated upon in the past three years at the Massachusetts General Hospital were correctly diagnosed prior to surgery.

Of 39 lesions in the lumbar region, 92 per cent were located at L4 or L5 (that is, below the fourth or below the fifth lumbar body), with L4 being twice as common as L5. Eight of these cases were "bilateral," that is the rupture extended across the midline producing bilateral involvement. A history of trauma, often relatively mild, was obtained in 60 per cent of the series.

Disregarding narrowing changes of the disk at L5 which are regularly difficult to evaluate, a decrease in width of the space of L4 disk was of localizing value in 25 per cent of all lumbar cases and in 33 per cent of L4 ruptures. (While the narrowing is suggestive of rupture it does not, of course, indicate whether the herniation is posterior or not, nor is it of significance in the prognosis.) Other changes of significance, especially if associated with the above, are loss of the usual lordotic curve and sciatic scoliosis.

The majority of the cases in this series varied from 25 to 45 years of age.

Previously the examination was made after injection of 2 c.c. of lipiodol into the cisterna magna but now the routine procedure is to inject 5 c.c. into the lumbar spinal canal. The examination may be made any time from immediately after injection up to several days or even several weeks later according to the convenience of the operator and condition of the patient. The examination is done on a tilting roentgenoscopic table, preferably with quick change-over switch to permit the obtaining of focal study roentgenograms promptly upon discovery of abnormalities in distribution of the oil while changing the position of the patient to shift the oil up or down the spinal canal space.

The determination of the spinal fluid protein by spinal puncture is done to show the indication for lipiodol study. The protein test was elevated definitely (over 50 mg. per cent) in 32 of the 39 cases, and slightly (40 to 50 mg.) in four more. The total protein content, however, decreases rapidly with the distance above the lesion, hence the withdrawal of spinal fluid should be from the same level as the lesion is suspected to occupy. The writers have encountered no severe reactions even with this larger injection of the oil.

By a large number of excellent artists' drawings and reproductions of roentgenograms, the authors illustrate the normal anatomy of the spinal canal and its contents, and the x-ray and operative findings in posterior herniation of the intervertebral disk, both unilateral and bilateral types. They conclude that by this improved technic, and the correlation of the clinical, laboratory, and x-ray findings, a correct pre-operative diagnosis should be possible in nearly every case presenting this condition.

J. E. HABBE, M.D.

THE TEETH

Roentgen Therapy of Paradentitis. Staunig and Neugebauer. Strahlentherapie, 1937, **59**, 526.

The authors relate their experience with the use of roentgen rays in the treatment of paradentitis. Technic: three fields were used, one anterior and two lateral areas. The radiosensitive organs like eye, parotid, and thyroid must be carefully protected. Each field receives one dose of 200 r at 140 kv. and 0.3 mm. Zn + 2 mm. Al; the interval between these three treatments is seven days. In the authors' experience the results were most satisfactory.

ERNST A. POHLE, M.D., Ph.D.

Evaluation of Dental Roentgen Findings in Relation to Focal Infection and Systemic Disease. Herman A. Osgood. Am. Jour. Roentgenol. and Rad. Ther., December, 1936, **36**, 751–756.

The use of a "slow" film and a fine focus tube with careful angulation of the incident ray, are essentials to accurate diagnosis of peri-dental disease. The first pathologic change demonstrable on the x-ray film is the widening of the black line of the pericementum at the apex, indicating thickening of this structure due to inflammatory congestion. The cause may be traumatic occlusion, inflamed or irritated pulp, or the first stage of an abscess formation. If the first roentgeno-

gram shows considerable destruction of the pericementum over the apex, the prognosis is poor even though there may be little destruction of the adjacent cancellous bone.

Scar bone is not necessarily the result of infection; it may occur in chemical irritation from root canal treatment or by injury (traumatic occlusion). Scar bone seen occasionally without close relation to the peri-dental tissues is of no significance except there be pressure irritation on a nerve.

If a pulpless tooth shows normal pericemental attachments and investing structures, it may not be a dead tooth and need not be extracted. On the other hand, a canal filling which shows a space between the gutta percha and the canal walls is worthless.

Removal of infected teeth showing granuloma or acute abscess is more apt to be effective in relieving systemic symptoms than removal of teeth in cases in which chronic abscess with scar bone formation has taken place.

J. E. Habbe, M.D.

Roentgen Diagnosis and Treatment with X-rays in Dental Conditions. J. Heiss. München. med. Wchnschr., March 26, 1937, **84**, 501–506.

Since the tooth is an integral part of the living body, its care should depend on co-operation between dentists and doctors. The progress of dentistry has in a large measure been tied up to the development of x-ray diagnosis. The author gives a rather elementary but complete and understandable discussion of the x-ray anatomy of the normal tooth, followed by a discussion of the diagnosis of the various diseases of the teeth and jaws. Much emphasis is placed on the ordinary diagnostic traps, such as confusion of normal foramina with abscesses. The use of contrast media in the diagnosis of cysts is mentioned; the discussion includes cysts, infections, and some tumors of the jaws.

The author, discussing the use of roentgen therapy in dental conditions, states that this is decidedly not the field of the dentist, but of the medical radiologist. He finds irradiation practically without value in dental abscess and pyorrhea. Good results are obtained in actinomycosis of the jaw, and he has seen cases rendered symptom-free for six years. He considers our knowledge of the results of radiation of malignant tumors of the jaw incomplete; post-operative radiation of adamantinoma and epulis has given good results in his hands. He has also obtained good results in osteomyelitis; even if exacerbation should occur, he finds the course of the disease shortened. He also advocates treating soft tissue inflammations and trigeminal neuralgia.

L. G. Jacobs, M.D.

TUBERCULOSIS, PULMONARY

The Incidence of Tuberculous Infection in American College Students. Esmond R. Long and Florence B. Seibert. Jour. Am. Med. Assn., May 22, 1937, **108**, 1761–1765.

The sharp upward trend of the tuberculosis mortality curve from the low level of pre-puberty years to the high level of early adult life coincides with the age period of the college student. The majority of cases of pulmonary tuberculosis still come to medical attention for the first time when already in an advanced state.

A survey of tuberculosis hospitals and sanatoriums in the United States, recorded 13.1 per cent of 66,631 patients as admitted in the minimal stage, and 29.7 and 57.2 per cent, respectively, as moderately and far advanced.

The reason for this general delayed diagnosis of tuberculosis lies in the fact that its symptoms are trivial in the early stage and commonly not serious enough to urge the patient to seek medical attention. Myers and Wulff observed the chests of the same individuals over years and saw lesions appear and progress to massive proportions without the individual suffering a single symptom. Diehl found 15 cases of active tuberculosis in 2,500 students. "Had we depended on physical examination and history alone for ordering x-rays of the chest, 10 of the 15 cases would have been missed."

At the University of Wisconsin, Stiehm recorded an increase of 430 per cent above a previous 14-year average, after the institution of a definite program for discovering cases of tuberculosis in the student body.

The tabulated results of standardized examinations at 20 colleges showed a geographic variation of incidence, probably a reflection of the level of tuberculous infection in the community concerned.

Charles G. Sutherland, M.B. (Tor.).

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